National Forest Inventory – British Columbia

Change Monitoring Procedures for Provincial and National Reporting

Prepared by the
Ministry of Sustainable Resource Management
Resource Information Branch

for the
Resources Information Standards Committee

March 31, 2005

Version 1.4

105-06262/

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Published by the
Resources Inventory Committee

Library and Archives Canada Cataloguing in Publication Data
Main entry under title:
Change monitoring procedures for provincial and national reporting [electronic resource]. -- Version 1.4 --

"March 31, 2005"
At head of title: National Forest Inventory – British Columbia.
Previous version issued by Resources Information Branch, 2003.
Available on the Internet.
Comprised of 2 v., of which v. 2 is appendix.
Includes bibliographical references: p.
ISBN 0-7726-5275-9

1. Vegetation surveys - British Columbia – Methodology – Handbooks, manuals, etc. 2. Forest surveys - British Columbia – Methodology – Handbooks, manuals, etc. 3. Environmental sampling – Handbooks, manuals, etc. I. British Columbia. Resources Information Standards Committee. II. British Columbia. Ministry of Sustainable Resource Management. Resource Information Branch. III. Title: National Forest Inventory, British Columbia : Change monitoring procedures for provincial and national reporting.

QK203.B7C42 2005   333.95'3'0723   C2005-960013-6

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Acknowledgments

The Government of British Columbia provides funding of the Resources Information Standards Committee work, including the preparation of this document. The Resources Information Standards Committee supports the effective, timely and integrated use of land and resource information for planning and decision making by developing and delivering focused, cost-effective, common provincial standards and procedures for information collection, management and analysis. Representatives to the Committee and its Task Forces are drawn from the ministries and agencies of the Canadian and the British Columbia governments, including academic, industry and First Nations involvement.

The Resources Information Standards Committee evolved from the Resources Inventory Committee which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII) and by Forest Renewal BC (FRBC), and addressed concerns of the 1991 Forest Resources Commission.

The data requirements for the National Forest Inventory closely parallel the attributes collected in the British Columbia Vegetation Resources Inventory (VRI) ground sampling program. The foundations for the procedures in this document are derived from the VRI program.

For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

Terrestrial Ecosystem Task Force

The Vegetation Inventory Working Group was formed in 1993 and issued their final report in March 1995 on a "Proposed New Inventory" for British Columbia. The Ministry of Forests, Resources Inventory Branch, in cooperation with the Ministry of Environment and other Ministry of Forests branches and consultants, developed the suite of Vegetation Resources Inventory Procedures based on the recommendations in that report. Many individuals were involved in writing the original version of the various Vegetation Resources Inventory Procedures documents.

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Modifications to CMI Ground Sampling Procedures for the Provincial Change Monitoring Inventory Program, Version 1.3, RISC 2003

1. Document figures and tables

   Numerous figures and tables in the document were updated to improve clarity and reflect National Forest Inventory (NFI) data collection rather than Vegetation Resources Inventory (VRI) procedures.

2. Section 2.6 – GPS Requirements

   Added section to clarify minimum GPS requirements.

3. Section 4.8 – Suitability for Age

   Revised wording for Suitability for Age to reflect NFI Requirements.

4. Section 4.8 – Direct Age Measurement

   Enhanced wording for whorl counts added.

5. VRI procedures removed

   All VRI procedures and Field Card references that are not related to the NFI have been removed.

6. Appendix A – Example Field Cards

   Field Cards not used in NFI have been removed

7. Appendix H – Latitude and Longitude for selected cities and Declination Values

   Coordinates for several cities corrected and declination values updated to 2005.

8. Appendix I – Modifications to marking procedures required by Land Custodian

   Revised to reflect NFI requirements

9. Appendix J – Basal Area Calculation

   Instructions added and table values corrected.

Table of Contents

Acknowledgments iii

Modifications to CMI Ground Sampling Procedures for the Provincial Change Monitoring Inventory Program, Version 1.3, RISC 2003 v

Table of Contents vii

List of Figures xii

List of Tables xiii

1. Introduction 1

Background 1

Principles of the Ground Sampling Process 1

How to Use This Document 3

2. Field Orientation and Navigation 5

Introduction 5

Objectives 5

General Procedures 5

Field Cards for this Section 6

Detailed Procedures 7

2.1 Locating and Marking the Tie Point 7

2.2 Navigating to the Reference Point 11

2.3 Establishing the Reference Point and Reference Tree 12

2.4 Establishing the Integrated Plot Centre 13

2.5 When the sample is inaccessible 14

2.6 GPS Requirements 15

3. Plot Establishment 16

Introduction 16

Objectives 16

Definitions 16
General Procedures 16
Field Cards for this Section 18
Detailed Procedures 18
3.1 Establishing the Plots at the Integrated Plot Centre 18
3.2 Taking Ground Photographs 23
3.3 Completing the Header Card (CH) 27
3.4 Completing the Compass Card (CP) 30
3.5 Completing the Cluster Layout (CL) Card) 31
4. Inventory Cruising 33
Introduction 33
Objectives 33
General Procedures 33
Field Cards for this Section 34
Detailed Procedures 34
4.1 Establishing Plot Layout 34
4.2 Identifying and Recording Tree Attributes 34
Marking the Plot Circumference 34
Dividing the Plot into Sectors 35
Tagging Trees 35
Tagging by Sectors 35
Attaching Tags to Trees 35
Tagging Forked Trees 36
4.3 Assessing Tree Attributes for Wildlife 42
4.4 Assessing Damage Agents and Severity 47
4.5 Assessing Tree Loss Indicators 48

4.6 Stem Mapping 55

4.7 Measuring Small Trees and Stumps 55

4.8 Recording Age/Height [Length] Tree Data 58

Literature Cited 69

5. Net Factoring 71

Introduction 71

Objectives 71

Definitions 71

General Procedures 71

Field Cards for this Section 72

Detailed Procedures 72

5.1 Net Factoring Procedures 72

5.2 Calculating Volume 73

5.3 Applying Deduction Rules 74

6. Call Grading 91

Introduction 91

Objectives 91

Definitions 91

General Procedures 91

Field Cards for this Section 91

Detailed Procedures 92

6.1 Call Grading Procedures 92

6.2 Grading Conventions and Guidelines 93

6.3 Inventory Call Grading Criteria 98

6.4 Summary of Log Grades by Species 123

7. Plants, Soils, and Old Growth 131

Introduction 131

Objectives 131

General Procedures 132

Field Cards for this Section 132

Detailed Procedures 133

7.1 Establishing Plots 133

7.2 Assessing Ecological Variability 133

7.3 Identifying and Recording Site and Soil Features 135

7.4 Describing Vegetation 158

7.5 Interpreting Succession 168

Literature Cited 179

8. Woody Debris 181

Introduction 181

Objectives 181

Definitions 181

General Procedures 181

Field Cards for this Section 182

Detailed Procedures 182

8.1 Establishing the Sampling Transects 182

8.2 Assessing the Transect Conditions 183

8.3 Sampling CWD Along the Transects 184

8.4 Sampling FWD on the Micro-plots 192

9. Range Resources 195

Introduction 195

Objectives 196

Definitions 196

General Procedures ... 197
Field Cards for this Section ... 197
Detailed Procedures ... 197
9.1 Establishing Forage Sampling Micro-Plots ... 197
9.2 Estimating Forage Utilization ... 198
9.3 Clipping the Plot ... 199
Literature Cited ... 201
Index ... 203

List of Figures

Figure 1.1 — Major activities in the ground sampling process. 4

Figure 2.1 — Components of field orientation and navigation. 6

Figure 2.2 — Example of completed access notes. 9

Figure 2.3 — Marking the tie point tree. 10

Figure 2.4 — Example of tag for the reference tree. 10

Figure 2.5 — Marking the aerial photo and ground sample point. 11

Figure 2.6 — Layout of Reference Pin and Integrated Plot Centre. 13

Figure 5.1 — Example of net factor calculation for Root Rot. 76

Figure 5.2 — Example of net factor calculation for Frost Cracks. 77

Figure 5.3 — Example of net factor calculation for Scar with known depth. 79

Figure 5.4 — Example of net factor calculation for Scar with unknown depth. 80

Figure 5.5 — Example of net factor calculation for Cat Face (cylindrical defect). 82

Figure 5.6 — Example of net factor calculation for Cat Face (conical depth). 83

Figure 5.7 — Example of net factor calculation for Cat Face (using butt rot table). 85

Figure 5.8 — Example of net factor calculation for Dead Tops. 87

Figure 5.9 — Example of net factor calculation for Broken Tops. 88

Figure 5.10 — Example of isolated sections between defects. 90

Figure 6.1 — Example of grade calculation for sun checked logs. 96

Figure 6.2 — Examples of grade calculation for twist. 97

Figure 7.1 — Assessing uniformity and attributes in areas with ecological variability within the 10 m fixed-radius plot. 134

Figure 7.2 — Side view showing meso slope descriptive terms 141

Figure 7.3- Example of recording horizon depth in organic soils and mineral soils. 150

Figure 7.4 - Mineral bulk density excavation sample depths 157

Figure 7.5- NFI Unknown plant label. 161

Figure 7.6 - Comparison charts for visual estimation of foliage cover 163

Figure 7.7 - An example of percent coverages in a plot, viewed from above 164

Figure 7.8 — Taller Vegetation Layers. 167

Figure 7.9 – Stratification of forest stands, shrubs, and trees. 174

Figure 8.1 — CWD transect encounters an anomaly within the plot. 184

List of Tables

Table 2.1 – Minimum settings for GPS data collection 15

Table 3.1 – Field cards for Ground Sample Types 29

Table 4.1 – Tree Status Codes 37

Table 5.1 – Formula for calculating volume. 73

Table 5.2 – Summary of procedures for determining net factor for loss indicators. 74

Table 5.3 – Deduction rule for Heart Rot Conk. 75

Table 5.4 – Deduction rule for Root Rot. 75

Table 5.5 – Deduction rule for Blind Conk 76

Table 5.6 – Deduction rule for Frost Crack. 77

Table 5.7 – Deduction rule for Scar. 78

Table 5.8 – Deduction rule for Cat Face. 81

Table 5.9 – Butt Rot guide for length deductions. 84

Table 5.10 – Deduction rule for Fork. 85

Table 5.11 – Deduction rule for Crook. 85

Table 5.12 – Deduction rule for Rotten Branch. 86

Table 5.13 – Deduction rule for Dead Tops. 86

Table 5.14 – Deduction rule for Broken Tops. 87

Table 5.15 – Deduction rule for Rot Associated with Broken Tops. 88

Table 5.16 – Deduction rule for Direct Observation. 89

Table 5.17 – Deduction rule for Other. 89

Table 6.1 – Minimum log lengths (in m) by grade and species (highest grade at left). 92

Table 6.2 – Butt rot guide for length deductions. 94

Table 6.3 – Maximum twist displacement by grade. 97

Table 6.4 – Fir/Pine/Larch Grades and Grade Requirements. 98

Table 6.5 – Cedar Grades and Grade Requirements. 103

Table 6.6 – Hemlock/Balsam Grades and Grade Requirements. 109

Table 6.7 – Spruce Grades and Grade Requirements. 113

Table 6.8 – Cypress/Yew Grades and Grade Requirements. 117

Table 6.9 – Deciduous Grades and Grade Requirements. 121

Table 6.10 – Fir/Pine/Larch log grade summary. 123

Table 6.11 – Cedar log grade summary. 124

Table 6.12 – Hemlock/Balsam log grade summary. 125

Table 6.13 – Spruce log grade summary......126
Table 6.14 – Cypress/Yew log grade summary......127
Table 6.15 – Coniferous Common Grades log grade summary......128
Table 6.16 – Deciduous Species log grade summary......129
Table 7.1 – Plot uniformity codes......135
Table 7.2 – Relative Soil Moisture Regime codes......136
Table 7.3 – Soil Nutrient Regime codes......137
Table 7.4 – B.C. Land Cover Classification codes in condensed form......139
Table 7.5 – Meso slope codes......141
Table 7.6 – Microtopography codes......142
Table 7.7 – Rocky substrate codes......142
Table 7.8 – Indicators of slope instability......143
Table 7.9 – Indicators of flood hazard......144
Table 7.10 – Surficial material codes......145
Table 7.11 – Soil features codes......146
Table 7.12 – Humus form codes......147
Table 7.13 – Soil colour codes......148
Table 7.14 – Examples of important soil horizons......148
Table 7.15 - Surface substrate classes and definitions......152
Table 7.16 – Suggested coding conventions for collected unknown species......159
Table 7.17 – Vegetation layer codes......166
Table 7.18 – Conversion factors from percent coverage to horizontal area......166
Table 7.19 – Site disturbance codes......169
Table 7.20 – Indications of site disturbances......171
Table 7.21 – Snags/CWD codes......173
Table 7.22 – Canopy gap codes......174
Table 7.23 – Vertical structure codes......174
Table 7.24 – Successional stability codes......175
Table 7.25 – Stand age codes......176
Table 7.26 – Structural stage codes......176
Table 8.1 — Coarse woody debris decay classes......189
Table 9.1 — Herbaceous forage utilization classes and codes......199

1. Introduction

The implementation of the British Columbia component of the National Forest Inventory [NFI] is designed to meet Provincial needs and to meet the needs of the Canadian National Forest Inventory. The procedures developed for the Ministry of Sustainable Resource Management Vegetation Resources Inventory (VRI) form the basis for the NFI. As the sample design is different, it has been necessary to modify some of the VRI procedures to suit the NFI design.

Background

Developing the ability to report on the current status of the forest resource in British Columbia and to monitor changes in the forest has become a serious need in the last few years. The National Forest Inventory – British Columbia Program (NFI-BC) was initiated to enable these new data needs to be met.

The permanent plot design of the NFI-BC allows for the repeated measuring of forest attributes at defined locations. While permanent plots have been used for more than 80 years to track changes in the growth of trees across the province, the NFI-BC has expanded the practice to include the monitoring and measurement of photo-based information. The program has also increased the set of ecologically based data collected on the ground.

The program is designed to provide status and trend data—at the provincial and, ultimately, national levels—on 25 attributes of sustainability. Up to now, reporting on the current state of the forest resource in British Columbia has relied on an annual summary of the information contained in all the province's map sheets. The permanent, re-measurable design of the NFI-BC puts in place a statistically based system of monitoring and reporting, which can be completed in conjunction with the national program.

The data requirements for the NFI closely paralleled the attributes collected in the British Columbia Vegetation Resources Inventory (VRI) ground sampling program. The foundations for the procedures in this document are derived from the VRI program.

Principles of the Ground Sampling Process

1. The National Forest Inventory will cover the entire "forested" land base of British Columbia, irrespective of ownership or vegetation values.
2. Sample plots will be selected randomly from a Provincial grid.
3. Moving plots to more typical locations is never acceptable. Sample plots must be placed where they fall. Special procedures will be used when this constitutes a temporary or permanent safety hazard.
4. All data attaches to the Integrated Plot Centre.
5. The ground sampling must be done correctly and carefully. Errors in the ground samples are translated directly into errors in the inventory. Accuracy is the watchword.

6. Quality of answer includes the concepts of no bias and small sampling error. It is achieved by ensuring the following:
   - No bias

     The sampling processes are statistically valid.

     Rounding and vague definitions are avoided.
   - Small sampling error

     The sample selection method may be combined with traditional stratification to ensure variance stabilizes more quickly than a random sample and that ensures controlled sample sizes in all land types.
7. Measurements are made to a known level of precision. Estimates made at the sample plot are acceptable where measurements cannot be taken.
8. All measurements are to be completed and recorded in the field.

How to Use This Document

This document deals with the ground sampling component of the National Forest Inventory in British Columbia. It describes procedures for the location and establishment of sample plots, and the collection of data related to:

- trees
- site, soils, plants and succession
- woody debris
- range resources

The major activities associated with the ground sampling process are illustrated in Figure 1.1. Sample tally sheets for recording field information are also included in this document. A handheld data entry program is also available for recording field information. The procedures for entering data in the handheld are not discussed in detail in this document.

A brief background is provided in Section 1 to explain the rationale behind the procedures. The remainder of the document describes the procedures or methods required for ground sampling.

- Section 2 and 3 describe the procedures required to locate and establish sample plots.
- Section 4 explains the measurement and recording of tree information at the Integrated Plot Centre.
- Sections 5 and 6 describe the call grading and net factoring criteria, guidelines, and rules.
- Section 7 describes the procedures required to gather site, soils, plants and succession information.
- Section 8 contains the procedures for measuring coarse woody debris, and
- Section 9 describes the procedures for measuring range resources.

Each of these sections contains a brief introduction, objectives, general procedures, and detailed procedures. Definitions, examples, and tips are also provided.

A glossary of terms and a detailed index are included in this document to ensure the usability of the document as a reference tool.

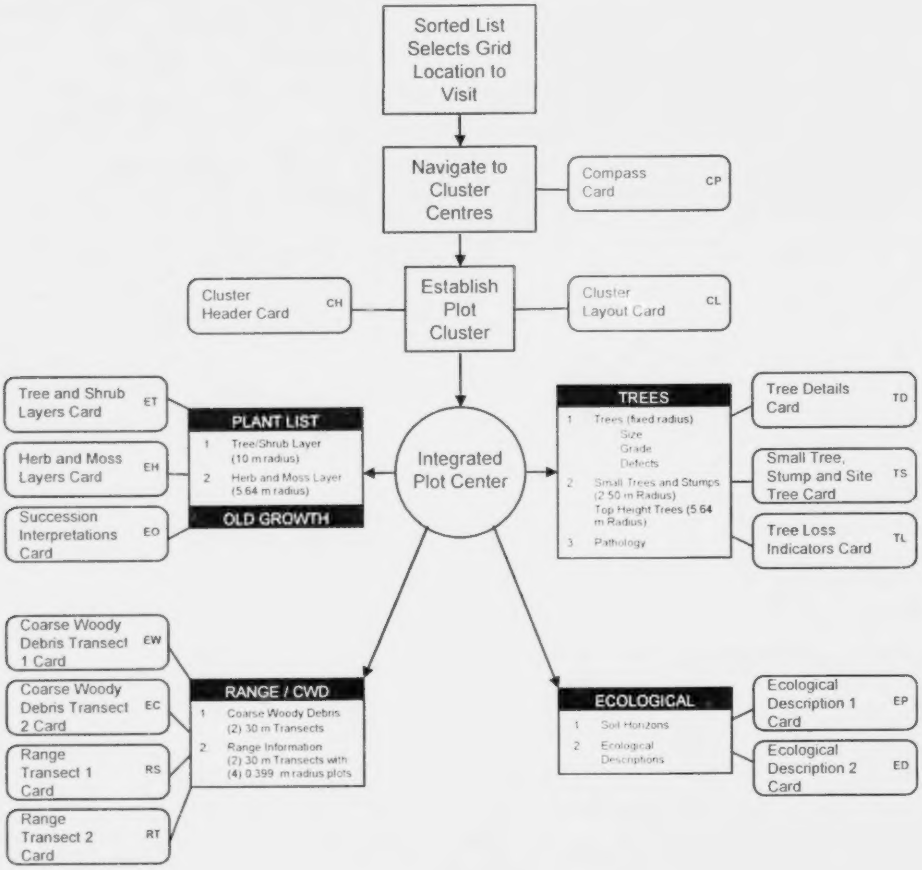
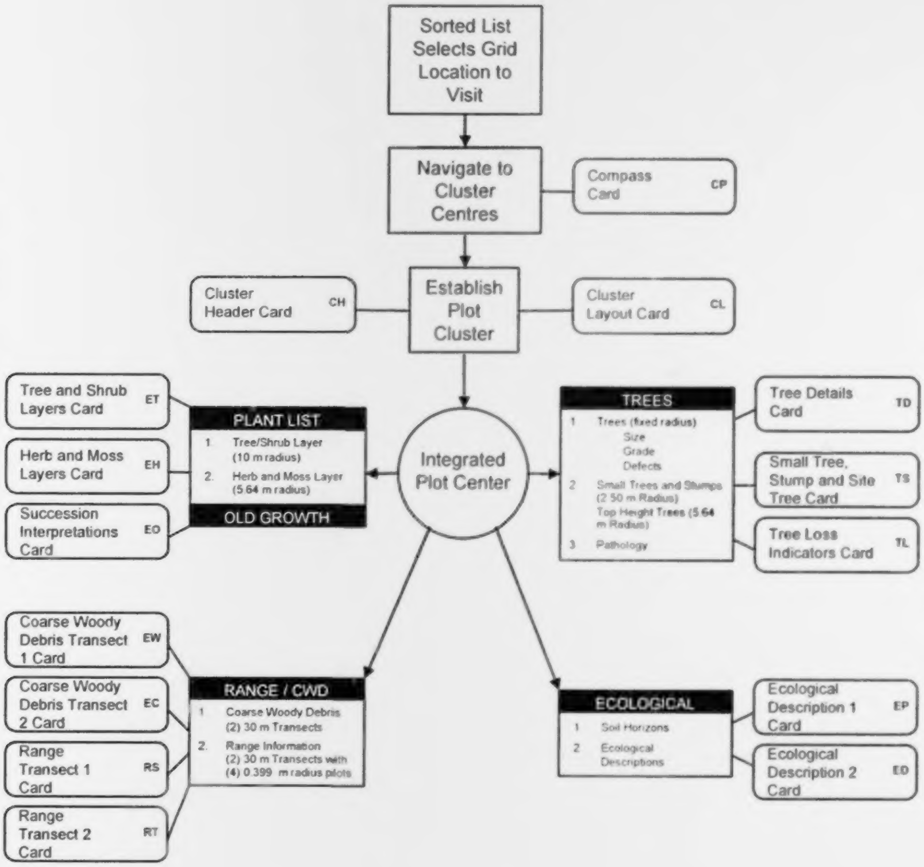

Sorted List Selects Grid Location to Visit
Navigate to Cluster Centres
Compass Card CP
Establish Plot Cluster
Cluster Header Card CH
Cluster Layout Card CL
Integrated Plot Center
Tree and Shrub Layers Card ET
Herb and Moss Layers Card EH
Succession Interpretations Card EO
PLANT LIST
1 Tree/Shrub Layer (10 m radius)
2 Herb and Moss Layer (5.64 m radius)
OLD GROWTH
TREES
1 Trees (fixed radius)
Size
Grade
Defects
2 Small Trees and Stumps (2.50 m Radius)
Top Height Trees (5.64 m Radius)
3 Pathology
Tree Details Card TD
Small Tree, Stump and Site Tree Card TS
Tree Loss Indicators Card TL
Coarse Woody Debris Transect 1 Card EW
Coarse Woody Debris Transect 2 Card EC
Range Transect 1 Card RS
Range Transect 2 Card RT
RANGE / CWD
1 Coarse Woody Debris (2) 30 m Transects
2 Range Information (2) 30 m Transects with (4) 0.399 m radius plots
ECOLOGICAL
1 Soil Horizons
2 Ecological Descriptions
Ecological Description 1 Card EP
Ecological Description 2 Card ED

Figure 1.1 — Major activities in the ground sampling process.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ECOLOGICAL
1 Soil Horizons
2 Ecological Descriptions
Ecological Description 1 Card EP
Ecological Description 2 Card ED

Figure 1.1 — Major activities in the ground sampling process.

2. Field Orientation and Navigation

Introduction

This section outlines the steps needed to traverse from a geographically located feature (the tie point) to the Integrated Plot Centre (IPC). The field crew is responsible for selecting suitable tie points, navigating to the reference point and IPC, and recording navigation information. The route must be suitably marked to locate the plot centre and to aid relocation in the near future (5-10 years).

Objectives

1. To locate the IPC at the given UTM co-ordinates for the sample.
2. To mark and document the IPC location and navigation points to allow for short and long-term sample relocation.
3. To facilitate no special treatment of the plots, the plot marking and tree marking will be hidden as much as practical.

General Procedures

Office Preparation

1. Prepare and become familiar with area characteristics and access prior to field visitation.
    - Identify the location of the IPC on the photo.
    - Identify the location of the IPC on the map.
    - Determine the relative accuracy of the map:photo relationship.
2. Locate a potential tie point and alternates on the map and photograph.

Field Location

1. Locate and confirm a tie point in the field and mark the Tie Point reference.
2. Navigate to the reference point.
3. Ensure you are in the correct ground position as indicated on the photo and by the UTM coordinates.
4. Place a steel or iron bolt in the end of a plot centre pin (to facilitate re-location with a metal detector). The head of the bolt should be large enough that it will sit on the top of the cylindrical pin and not fall through it. Drive the Reference Pin fully into the ground.
5. Blaze and tag the Reference Tree and measure the bearing and distance to the Reference Pin. Place tag at ground level.
6. Measure the final 15.00 m to the IPC, place a steel or iron bolt in the end of a plot centre pin and drive it fully into the ground.

A simple illustration of the components of field orientation and navigation is contained in Figure 2.1.

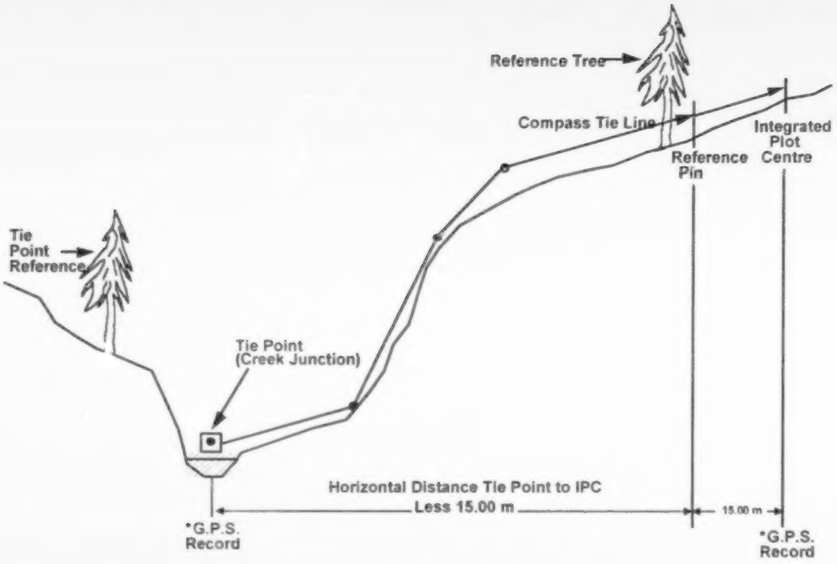


Figure 2.1 — Components of field orientation and navigation.

Field Cards for this Section

Header Card (CH) (Appendix A, Figures A.1 and A.2)
polygon ID, project ID, sample plot, date, crew, general notes and access details.

Compass Card (CP) (Appendix A, Figures A.3 and A.4)
Tie Point Tree, Reference Pin Location, Reference Tree, GPS, location, field survey notes.

Cluster Layout (CL) (Appendix A, Figures A.5 and A.6)
Integrated plot details, sample cluster details.

Detailed Procedures

Standard procedures of location, marking, and recording must be followed so that sample plots are easy to relocate for quality control and re-measurement purposes. The following procedures are designed to be used with current field survey tools, such as compass, clinometer, and distance-measuring equipment. Traditional survey methods can still be used as the primary method of plot location with GPS used to assist in confirming the location.

Now that the selective availability of GPS has been turned off, GPS is another tool that can be used to locate the sample plot location. It is recommended that GPS only be used up to the location of the reference point. There can still be error in GPS readings, especially in dense timber and on steep slopes. The crew still needs to confirm that the sample is in the correct location. In order for the crews to avoid complex calculations in the field, the reference pin when using GPS for navigation can be set at a point 15m due south of the IPC. The UTM for the reference point would be found by subtracting 15m off the intended IPC Northing UTM, and using the same Easting as the intended IPC. Once the reference pin is established the field crews can tight chain 15m due north of the reference pin to locate the IPC.

Note: When using this method the true location of the IPC will not always be 15m due North of the Reference pin because the UTM grid is not always orientated to true North. The errors over the 15m distance to the IPC are considered negligible for NFI purposes.

GPS data will be recorded at the access point (if established), tie point, and the Integrated Plot Centre. Basic GPS requirements for NFI are outlined in section 2.6. Detailed standards and procedures for GPS data collection can be found in the document: "British Columbia Standards, Specifications and Guidelines for Resource Surveys Using Global Positioning System (GPS) Technology, Release 3.0." This document is available on the Resources Information Standards Committee website (http://srmwww.gov.bc.ca/risc/).

2.1 Locating and Marking the Tie Point

A tie point is selected and marked to ensure it can be found again with reasonable effort using the field crew's documentation.

Office Preparation

1. **Locate the tie point:**
   - The field crew is responsible for the selection of a suitable tie point. A tie point should have the following characteristics:
     - must be locatable on the ground
     - should be locatable on the appropriate mid-scale aerial photo and/or orthophoto
     - should be locatable on the appropriate forest cover map
     - should permit efficient access to the sample
   - Some possible locations are:
     - major road junction (use the intersection of the road centrelines)
     - pre-located corrected GPS coordinates

- bridge on a stream crossing (on small creeks use the centreline of the bridge at the middle of the creek; on larger streams specify which edge of the stream was used)
- definite timber boundary features on the photo (use caution when using cutblock edges as there may have been additional harvesting, or the map placement may be inaccurate)
- singular tree or small clump of trees
- major creek junctions
- well-defined swamps, ponds, or lake edges

2. **Locate the sample:**
   - The sample location will be marked on the forest cover map, orthophoto and/or field aerial photo by the project manager(s) prior to sampling.
   - Observe the sample location and potential tie point locations on the map and the photo (in stereo). Select primary and secondary tie point locations.

Note: Radial-line plotters may be used to transfer the potential tie point locations from the document aerial photo to the field map. Confirm the accuracy of the tie point location.

Field Location

1. **Describe the access point:**
   - The crew must record access notes to aid in navigation on the back of the Header Card or in the appropriate section of the handheld data entry program. The notes should include a narration of the route traveled from a known location (for example the junction of a highway and a secondary road) to the tie point, in enough detail to aid relocation by a different crew for re-measurement in approximately 5 to 10 years.

Note: An increasing number of samples are being visited by various field crews, which may or may not have GPS capability or GPS data was not available at the site. Extra effort should be made in providing detailed access notes for future visitation.

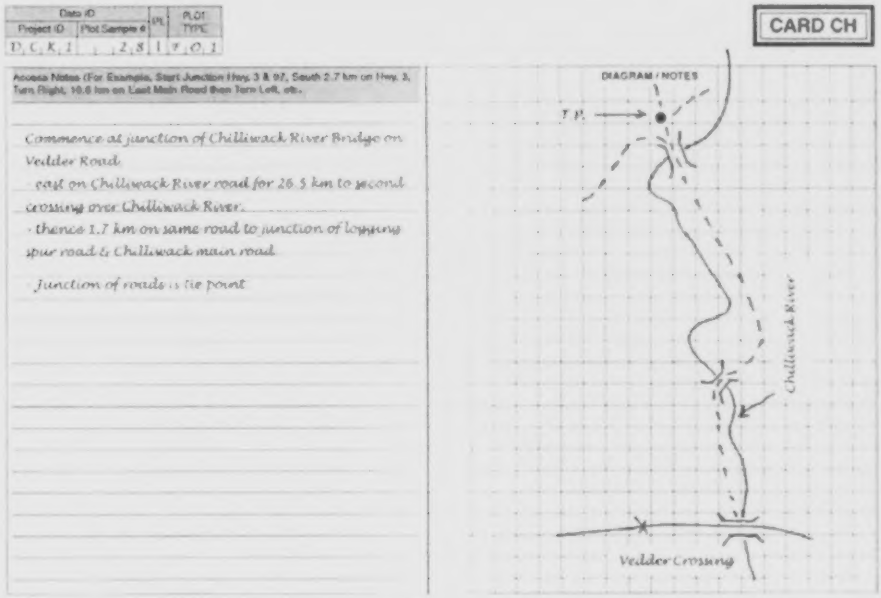


DIAGRAM / NOTES
T.P.
Chilliwack River
Vedder Crossing

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
DCK1	28	1	FO1

CARD CH

Access Notes (For Example, Start Junction Hwy. 3 & 97, South 2.7 km on Hwy. 3, Turn Right, 10.6 km on Last Main Road then Turn Left, etc.

Commence at junction of Chilliwack River Bridge on Vedder Road

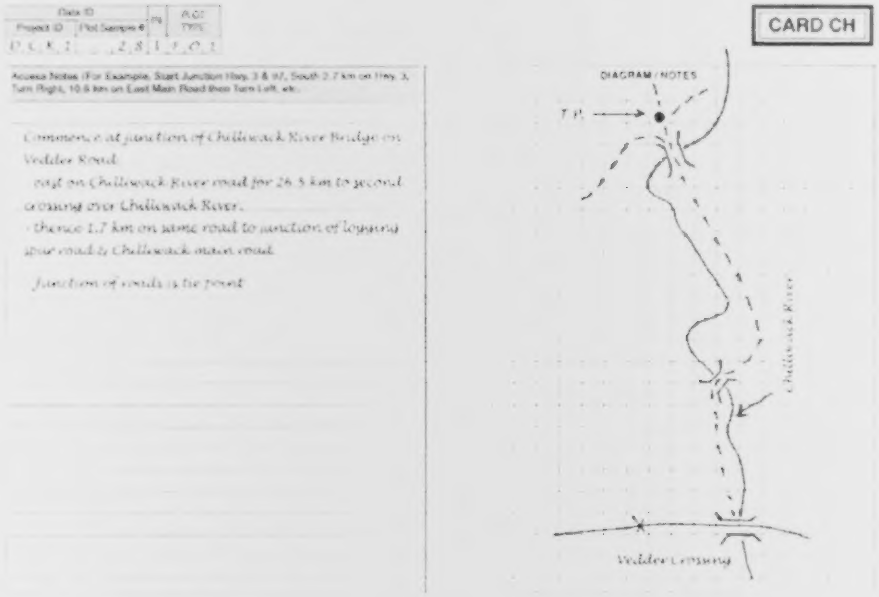
- east on Chilliwack River road for 26.5 km to second crossing over Chilliwack River.
- thence 1.7 km on same road to junction of logging spur road & Chilliwack main road
- Junction of roads is tie point

Figure 2.2 — Example of completed access notes.

In some instances the tie point will not be directly accessible. For example, the crew may need to land at a helispot in a swamp and navigate to the tie point using rough bearings and distances; or the crew may walk to the corner of a "cut block" and then traverse from this point. This initial starting point is referred to as the Access Point and the following information should be recorded:

- Record GPS file number in the field for 'GPS Access Point.'
- Describe the location. If more detail is required, use the Comments section on the CP field card.
- Note the bearing(s) and distance(s) from the access point to the tie point in the Comments section.

2. **Establish the tie point in the field:**
   - Confirm the tie point location or select an alternate
   - Select a Tie Point Tree or stump of suitable size (20+ cm dbh) so that the stem will be present for a number of years (not beside a road where it may be removed during road maintenance).
   - Where no suitable trees or stumps are available, use another feature, such as a rock cut, boulder, and so on. A small rock cairn can aid relocation.
3. **Mark the tie point tree for relocation of the samples in the short term (up to 5 – 10 years):**
   - Make the tie point visible to a field crew conducting surveys, but not overly visible to the general public. For example:
     - if available the tree should be greater than 20 cm in diameter
     - choose conifers over deciduous, cedars over other conifers
     - limb the complete stem to shoulder height
     - remove understorey vegetation around the tree, if practical



CARD CH

Data ID			
Project ID	Plot Sample #	FS	PLOT TYPE
D C K 1	2 8	1	F O 1

Access Notes (For Example, Start Junction Hwy. 3 & 97, South 2.7 km on Hwy. 3, Turn Right, 10.6 km on East Main Road then Turn Left, etc.

Commence at junction of Chilliwack River Bridge on Vedder Road.
- east on Chilliwack River road for 26.5 km to second crossing over Chilliwack River.
- thence 1.7 km on same road to junction of logging spur road & Chilliwack main road.

Junction of roads is tie point

Figure 2.2 — Example of completed access notes.

In some instances the tie point will not be directly accessible. For example, the crew may need to land at a helispot in a swamp and navigate to the tie point using rough bearings and distances; or the crew may walk to the corner of a "cut block" and then traverse from this point. This initial starting point is referred to as the Access Point and the following information should be recorded:

- Record GPS file number in the field for 'GPS Access Point.'
- Describe the location. If more detail is required, use the Comments section on the CP field card.
- Note the bearing(s) and distance(s) from the access point to the tie point in the Comments section.

2. **Establish the tie point in the field:**
   - Confirm the tie point location or select an alternate
   - Select a Tie Point Tree or stump of suitable size (20+ cm dbh) so that the stem will be present for a number of years (not beside a road where it may be removed during road maintenance).
   - Where no suitable trees or stumps are available, use another feature, such as a rock cut, boulder, and so on. A small rock cairn can aid relocation.
3. **Mark the tie point tree for relocation of the samples in the short term (up to 5 – 10 years):**
   - Make the tie point visible to a field crew conducting surveys, but not overly visible to the general public. For example:
     - if available the tree should be greater than 20 cm in diameter
     - choose conifers over deciduous, cedars over other conifers
     - limb the complete stem to shoulder height
     - remove understorey vegetation around the tree, if practical

- if appropriate, blaze the tree above breast height taking care not to girdle the tree
- blaze tree on 4 sides
- spray paint the blazed surfaces
- ribbon the tree bole

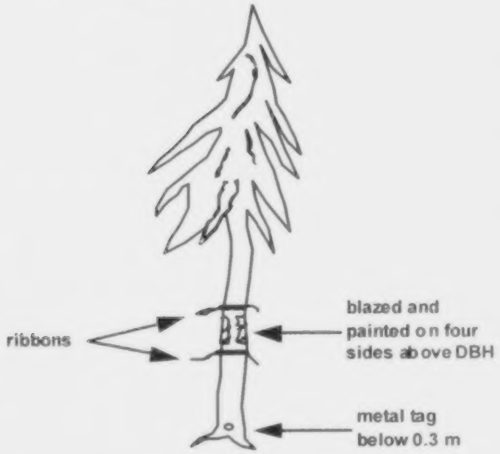


Figure 2.3 — Marking the tie point tree.

- Record the species, diameter, azimuth and distance from the Tie Point Tree to the tie point on the Compass Card (CP). (Completing the Compass Card is discussed in Section 3.5.)
- Measure the bearing and horizontal distance from the face of the Tie Point Tree to the tie point. Where the tie point is a singular tree; this tree may be blazed and marked. The bearing is recorded as "000" and the distance is 0.0 m.
- Securely nail the aluminum identification tag with aluminum nails (Figure 2.4) at the base of the tree below potential felling height (0.3 m) as shown in Figure 2.3. If practical, the tag should face the tie point location. Record the number on the compass card (CP).

Note: Tree marking, blazing, and ribboning must be coordinated with the appropriate land manager or owner.

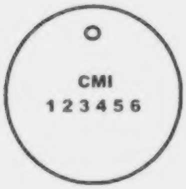


Figure 2.4 — Example of tag for the reference tree.

4. **Mark the field photo and field map (Figure 2.5):**
   - Locate the selected tie point and pin-prick the location on the field photo, and/or orthophoto.

- Record the following information on the back of the photo: project identity; plot sample number; azimuth directions and distances from tie point to Integrated Plot Centre.
- Locate and mark the tie point and the ground sample point on the field map.
- Record the same information as above on the map.

Note: The tie point must be placed in its relative position on the map. It is not enough to specify a road junction on both the photo and map without making sure that the map is accurate in its relative placement of that road junction.

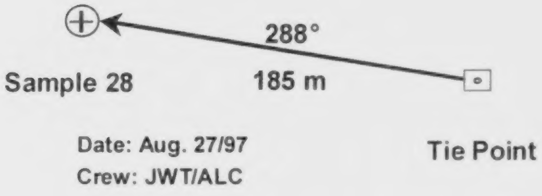


Figure 2.5 — Marking the aerial photo and ground sample point.

5. **Collect GPS data at the tie point location and record the file ID:**

   When GPS data cannot be collected at the Tie Point, move to an area where data can be collected (such as an opening). Measure the distance and bearing from the point where GPS data was gathered back to the tie point and record in the appropriate section on the Compass Card. If GPS data cannot be collected at this alternate site, enter NODATA for the GPS file ID.

2.2 Navigating to the Reference Point

From the Tie Point navigate to the Reference Point location.

Procedures

1. Locate the Reference Point using appropriate methods.
2. Use offsets to traverse around unsafe or difficult situations.
3. Correct all measured distances to the horizontal.
4. Flag the tie line well enough to be easily followed. Flagging is to aid in short-term relocation of the IPC (within one field season).
5. Evaluate the location. If the air photo and ground location agree, proceed with establishing the Reference Point and Reference Tree. If the air photo and ground location do not agree, evaluate the problems and find the correct sample location. The objective is to find the **correct ground location** as per the given UTM co-ordinates of the sample point. You will not be "moving" the plot location if there is a conflict, you will be "finding" it. The map, GPS, and other tools are aids in finding the correct location.

   There are a number of possible sources of error:
   - wrong starting point

- incorrect bearing
- wrong compass declination
- significant local magnetic attraction
- error in base map
- no/poor GPS reception

Some possible solutions are:

- Return to the tie point and re-run the tie line.
- Select another tie point and traverse from this point to the sample.
- If the original calculations are in error you may be able to establish the location relative to known features near you and calculate the distance and bearing to the correct location.
- Move to a location where GPS can be collected. Note the UTM coordinates of this location, determine distance and bearing to the reference pin, navigate to this point using tape and compass.

2.3 Establishing the Reference Point and Reference Tree

The purpose of establishing a Reference Point is to eliminate potential small-scale bias for the Integrated Plot Centre location. The Reference Point will also help in relocating the IPC. In standard forest conditions the reference tree will be marked as follows. If the sample occurs on sensitive areas the project manager will designate that hidden plot procedures are employed (Appendix I).

Procedures

1. Measure from the Tie Point along the predetermined azimuth direction towards the location of the IPC, using appropriate field methods.
2. Stop 15.00 m short of the full distance. Establish the Reference Pin at this point.
3. Place a steel or iron bolt in the end of a plot centre pin (to facilitate re-location with a metal detector). The head of the bolt should be large enough that it will sit on the top of the cylindrical pin and not fall through it. Drive the pin firmly into the ground until top of pin is level with the ground surface. If the pin can not be embedded to this depth, remove the excess length (with a pipe cutter or hacksaw). If appropriate, establish a small rock cairn at the pin location.
4. Choose a suitable Reference Tree (greater than 20cm dbh, if possible). The Reference Tree should be reasonably close, in relatively good health, with a high probability of survival. The Reference Tree should not be a tree in the sample plots.
5. Measure the bearing and distance from the tag on the Reference Tree to the Reference Pin.
6. Record the Reference Tree details on the Compass Card (discussed in Section 3.5).
7. Mark the tree with flagging tape and blaze on four sides above DBH. The blazing should be visible but not severe enough to kill the tree. Paint the blazes to enhance visibility and to protect the tree from insects and pathogens.
8. Nail a pre-numbered metal tag with aluminum nails to the base of the tree below where the tree would be cut if it was harvested, and facing the Reference Pin. If site conditions make this impossible, the tag location is at the discretion of the crew. The tag is scribed as shown in Figure 2.4. Record the tag number on the Header Card (CH).

2.4 Establishing the Integrated Plot Centre

Measure to the Integrated Plot Centre from the Reference Point.

Procedures

1. Accurately measure the remaining 15.00 m along the correct bearing to the IPC to eliminate any possible small-scale bias in placing the centre (Figure 2.6).This point is the Integrated Plot Centre regardless of the site or conditions. The plot centre may be in an open forest, a rocky area, a road, a creek, or inside a standing tree.

Note: If you feel that the site is unsafe or poses an undue hazard, the sample may be dropped (see Section 2.5). The project supervisor will review other means of completing these hazardous samples.

---

2. Place a steel or iron bolt in the end of a plot centre pin (to facilitate re-location with a metal detector). The head of the bolt should be large enough that it will sit on the top of the cylindrical pin and not fall through it. Drive a pin fully into the ground at the IPC. If site conditions make it impossible or inappropriate to imbed the aluminum pin at the IPC, place it as close as possible to the plot centre, and record the offset distance and bearing from the pin to the plot centre on the Cluster Layout (CL) card (Figure A.5).

3. Collect GPS data at the IPC. When GPS data cannot be collected at the plot centre, move to an area where data can be collected. Measure the distance and bearing from the point where data was collected back to the IPC. Record these measurements in the appropriate section on the Cluster Layout card. If GPS data cannot be collected at this alternate site , enter NODATA for the GPS file ID.

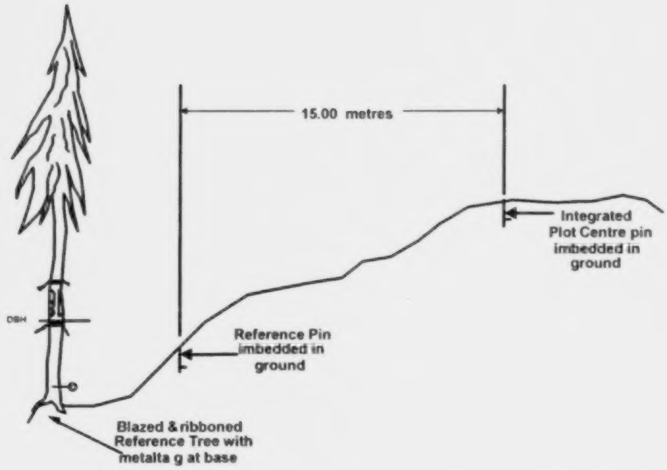

15.00 metres
Integrated Plot Centre pin imbedded in ground
DBH
Reference Pin imbedded in ground
Blazed & ribboned Reference Tree with metalta g at base

Figure 2.6 — Layout of Reference Pin and Integrated Plot Centre.

2.5 When the sample is inaccessible

In some instances, the complete sample or some part will not be accessible because of factors such as dangerous slopes, denied access, or physical safety concerns. It may be readily apparent from the tie point or earlier that the area is inaccessible, or only as the sample location is approached. In some cases, small unmapped local features such as beaver ponds and water bodies may be encountered. The field crew is not expected to sample beyond what is considered reasonable and safe. For example, if the water level is above the "boot tops," then estimate the attributes if possible or drop the plot if reasonable estimates cannot be made. **The safety of the field crew is the first priority.**

Complete as much information as possible on the field cards, maps, and photos to the point where field work was terminated. It is appropriate to estimate the portion of a sample not physically accessible [for example if the last few metres of a line transect is inaccessible but it can be seen that no pieces or a few pieces have to be estimated it is preferable to record the estimate(s) rather than recording the line portion as not sampled]. In another example, if ½ of the large tree plot is accessible and ½ is not accessible but can be estimated it is preferable to estimate the inaccessible portion.

When a sample is dropped, complete the CH card and return it to the project manager. Specify why the sample cannot be established, for example:

- access to plot is too dangerous
- plot would be located in an unsafe area
- plot would be located in a river or lake
- permission denied to access private land

Provide detailed comments as required.

2.6 GPS Requirements

The Access point, Tie point and IPC are to have GPS data collected and post processed.

The GPS hardware and software must be capable of achieving a target accuracy of 10 meters horizontal and 15 meters vertical, for 95% of the points collected in a feature using standard single-frequency pseudo-range differential correction techniques.

Offsets are to be recorded on the field cards and the coordinate that will be keypunched in the data entry program will have the offset already included. Final GPS coordinates must be entered into the ground sample data entry program before submission.

GPS reference stations must conform with the requirements shown in: "British Columbia Standards, Specifications and Guidelines for Resource Surveys Using Global Positioning System (GPS) Technology, Release 3.0." This document is available on the Resources Information Standards Committee website (http://srmwww.gov.bc.ca/risc/).

GPS Criteria	Setting
Position Mode	3D only, 2D fixes are not acceptable
Elevation Mask	> 15
GDOP	< 10
PDOP mask	< 8
HDOP mask	< 5
PDOP switch	8
SNR mask	4
Logging interval	1 second
Minimum number of positions in feature	200
Not in feature rate	All

Table 2.1 – Minimum settings for GPS data collection

3. Plot Establishment

Introduction

This section outlines the layout of plots and measurement procedures at the Integrated Plot Centre. For more detailed procedures refer to the appropriate sections.

Objectives

To establish sample plots for the National Forest Inventory.

Definitions

The National Forest Inventory sample design consists of a series of sample data and sampling designs relating to a single plot centre. The location of the sample is pre-determined, using statistically appropriate procedures.

The **Integrated Plot Centre** is the location around which the detailed sample information will be collected. All attributes are attached to the plot centre point (See Figure 3.1).

General Procedures

1. Confirm that the Integrated Plot Centre is in the correct location.
2. Assess safety considerations.
4. Determine and carry out the sequence of activities.
    - Assess the site vegetation and determine the most efficient sequence of measurements to ensure that specific values are not degraded by other activities. For example, on a site that has forage value, plants of interest may be trampled if tree heights are measured first.
5. Record the Integrated Plot characteristics (for example, project and sample ID, type of plot, plot radii).

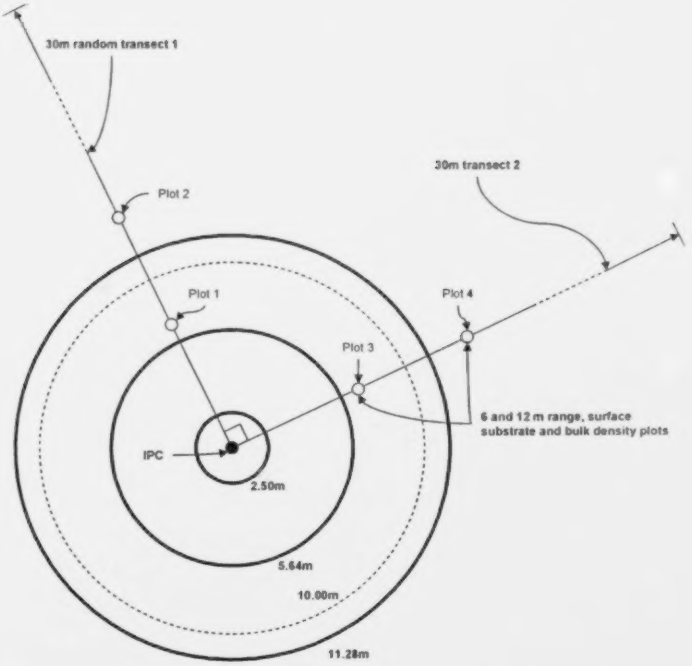


Figure 3.1 — Layout of sampling plots and transects and summary of data collected.

All attributes collected on the sample are attached to the location of the plot centre point

Sampling methodology	Data collected
2.50 m fixed-radius	small tree and stump data
5.64 m fixed-radius	tree details ≥ 4cm dbh, top height tree, vegetation species and cover percent (herbs, grasses, bryoids)
0.04 hectare quadrants	site tree details
Within 10 m fixed-radius	estimated tree and shrub cover percentage, ecological data, soil pit
11.28 m fixed radius	tree details ≥ 9cm dbh
Approximately 25 m radius	succession interpretations, slope gradient, aspect, old growth, etc.
30 m line transects	coarse and small woody debris, surface substrate
0.399 m radius along each line transect at 6 m and 12 m	Range, fine woody debris, location for bulk density sampling

Field Cards for this Section

Header Card (CH) (Appendix A, Figures A.1 and A.2)
Polygon ID, project ID, sample plot, date, crew, notes

Compass Card (CP) (Appendix A, Figures A.3 and A.4)
Tie-Point Tree, Reference Pin Location, Reference Tree, GPS, file numbers, field survey notes

Cluster Layout (CL) (Appendix A, Figures A.5 and A.6)
Integrated plot details sample cluster details

Detailed Procedures

Depending on the sequence of measurements, perform the functions described below.

3.1 Establishing the Plots at the Integrated Plot Centre

Tree Detail Plot

1. Establish a 5.64m fixed-radius plot (Figure 3.2), for trees 4.0 cm DBH and larger.
2. Establish an 11.28m fixed-radius plot (Figure 3.2) for trees 9.0 cm DBH and larger.
3. Number the trees sequentially clockwise in sectors from the north.
4. Make detailed measurements on the selected "in" trees for diameter, length, grade, wildlife tree attributes, damage agents, loss indicators, and other details.

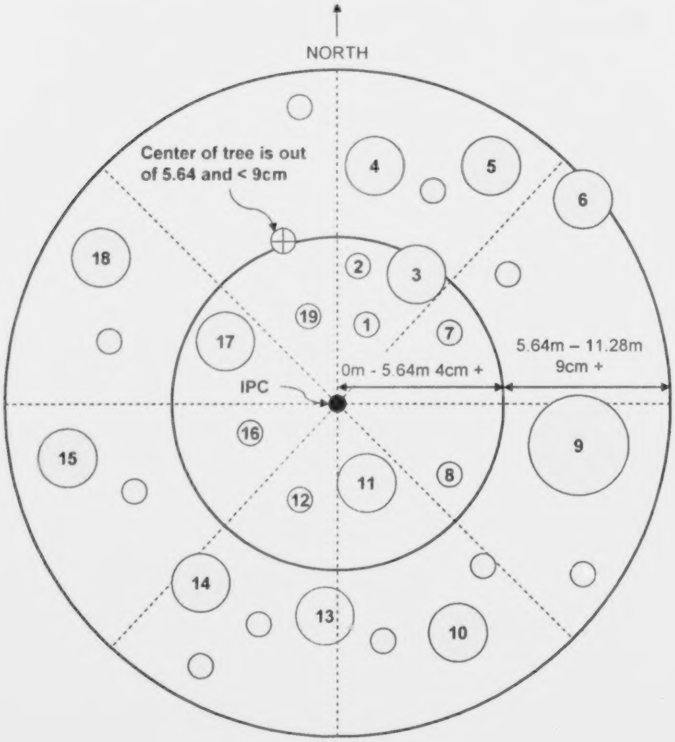


Figure 3.2 — 5.64m and 11.28m fixed-radius plot layout.

Small Tree and Stump Plot (2.50 m fixed-radius)

1. Establish a 2.50 m fixed-radius plot, centred on the Integrated Plot Centre (Figure 3.1).
2. Count live trees less than 4.0 cm DBH and more than 30 cm in length. Record in two predetermined classes.
3. Collect stump data (larger than 4.0 cm top diameter inside bark and less than 1.3 m in height) on this plot.

Top Height Tree Plot (5.64 m fixed-radius plot)

1. Establish a 5.64 m fixed-radius plot, at the Integrated Plot Centre (Figure 3.3).
2. Measure a top-height tree, if a suitable tree is available within this plot.
3. Determine the species composition (by basal area) for the sample.
4. Measure a site tree of the species leading in basal area, if a suitable tree is available within each quadrant.

5. Measure a site tree of the next species in order of basal area, if a suitable tree is available within each quadrant.

The first tree selected at the IPC is the top height tree; for example this tree may be a cedar tree. After completing the sample, the leading species by basal area for the sample is determined to be cedar. The cedar tree may also be the "leading species tree" and the data will be copied into the leading species information data fields. Alternatively, if the sample leading species by basal area is hemlock, then the cedar tree may be the second site tree and the data will be copied as required.

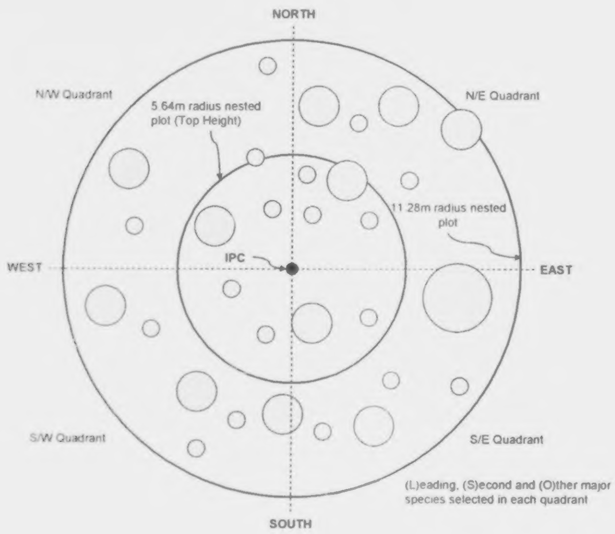

NORTH
N/W Quadrant
5.64m radius nested plot (Top Height)
N/E Quadrant
11.28m radius nested plot
WEST
IPC
EAST
S/W Quadrant
S/E Quadrant
(L)eading, (S)econd and (O)ther major species selected in each quadrant
SOUTH

Figure 3.3 — Top-height tree 5.64 m fixed-radius plot.

Ecological Data Plots

1. Establish a full fixed-radius plot (10 m radius) – centred on the Integrated Plot Centre – to measure trees and shrubs (Figure 3.4).
2. Establish a full fixed-radius plot (5.64 m radius) to measure herbs, grasses, and bryoids.
3. Within a 25 m radius of the Integrated Plot Centre determine succession and old-growth characteristics of the Integrated Plot Centre within the 11.28 m plot.
4. Establish a soil pit describing the Integrated Plot Centre within the 10 m radius plot.

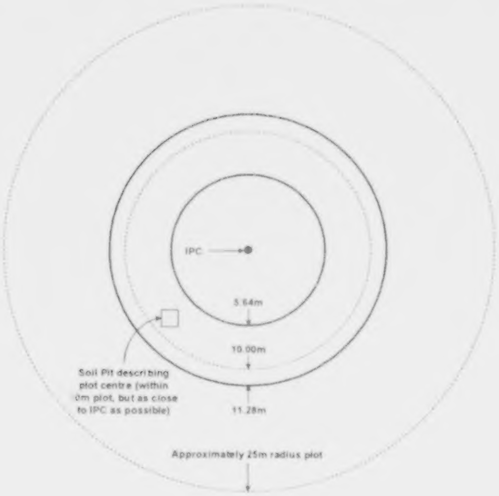

IPC
5.64m
10.00m
Soil Pit describing plot centre (within 0m plot, but as close to IPC as possible)
11.28m
Approximately 25m radius plot

Figure 3.4 — Ecological data collection plot layout.

Coarse Woody Debris Line Transects

1. Establish a 30m horizontal line transect from the Integrated Plot Centre along a previously selected random bearing (Figure 3.5).

2. Measure all woody debris greater than 1.0 cm diameter, in appropriate classes as shown in section 8.1, at the point of intersection.

3. Include detailed measurements at the transect crossing point on diameter, tilt angle, and decay class. Also record species and piece description.

4. Establish a second 30 m transect from the Integrated Plot Centre at plus 90° from the first line and take measurements again.

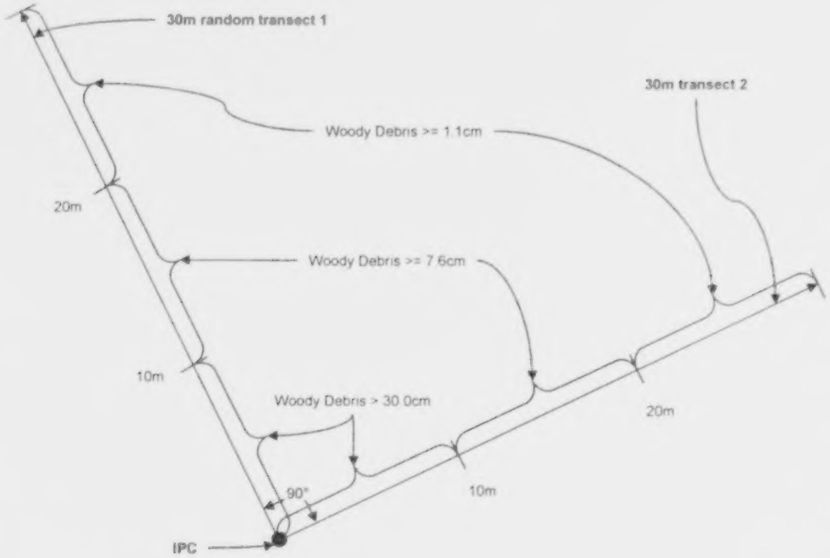


Figure 3.5 — Woody debris line transect layout

Forage Production Micro-Plots

Forage Production Plots

1. Establish four plots of 0.399 m radius on the woody debris transects at 6 m and 12 m from the Integrated Plot Centre (Figure 3.6).
2. Determine the forage utilization.
3. Collect and label samples of forbs and graminoids.

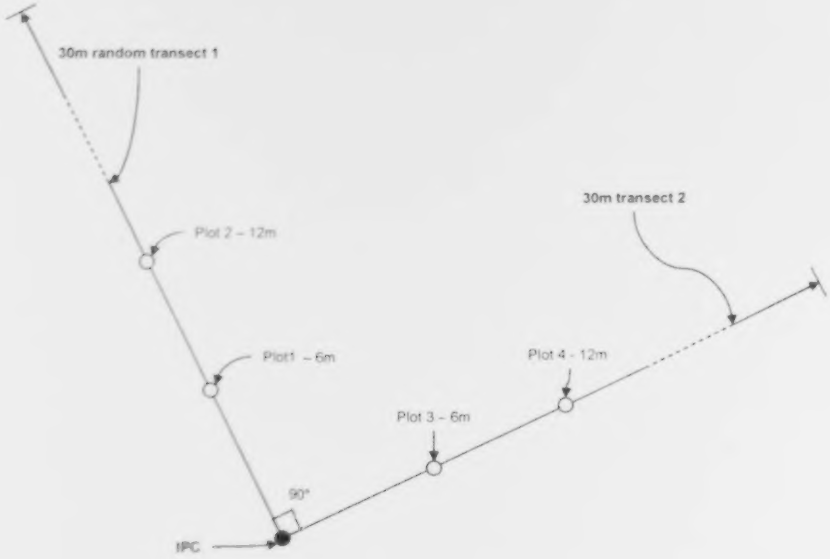


Figure 3.6 —Forage production micro-plots layout

3.2 Taking Ground Photographs

A series of ground photos will be taken at each Integrated Plot using a quality 35 mm camera with flash. The use of disposable cameras is not recommended. The print negatives will be digitally scanned and stored as files for reference by various future users. If digital cameras are available, they can be used to create the files directly.

Objectives

The photos will be available as digital data for:

- initial assessment by potential users who may want to sub-sample on these locations for other values; and
- "capturing" some information that is not directly measured.

Procedure

Take a minimum of eight photos at each Integrated Plot location. The required photos are as follows:

1. a close-up of the Integrated Plot Centre pin
2. a photo along the first random-bearing transect line
3. a photo along the second random bearing transect line
4. a photo along the reverse of the first random-bearing transect line
5. a photo along the reverse of the second random-bearing transect line
6. a photo representative of the sample vegetation and structure at the IPC

7. a photo of the forest canopy directly overhead at the IPC
8. a photo of the soil profile that has been described in the soil pit.

Do not cut trees or vegetation to provide an unobstructed view.

Take the photo before taking measurements if the site may be damaged during sampling.

1. Photograph the IPC Pin at a steep angle (about 60°) above the pin showing the pin and the ground for approximately one metre or more around the pin so the vegetation can be seen (Figure 3.7). Include something to record the plot number, particularly on this photo.
2. Photograph the random-bearing transects from a position behind the plot centre pin (Figure 3.8).
   - Include the IPC Pin in the foreground, if possible.
   - Include something for relative scale determination.
   - Try to include the various crown levels with a "portrait" (vertical) format, if required.
3. For a representative photo, photograph a portion of the plot which the crew considers representative of the sample vegetation and structure (Figure 3.9). Include the IPC and an item for scale in the photo.
4. Photograph any other unusual features that you think would be of interest to users of this data. You may wish to illustrate issues about the sampling process, such as when rules do not seem clear or appropriate. Make notes about these photos so the points can be addressed later.
5. Try to include people in each photo for scale. Use a scale in any close-up photos.
6. Include the plot number in the photo.
7. Record the photos taken (roll and photo number) and any comments on the (CH) Header Card.

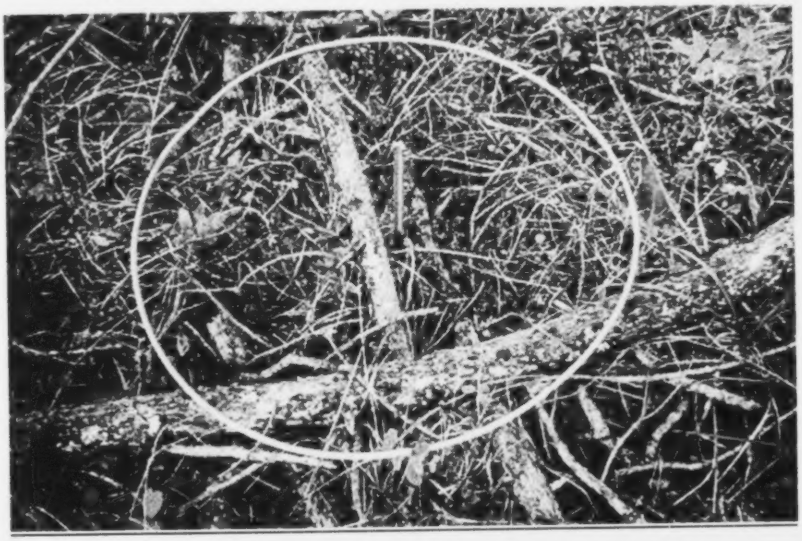


Figure 3.7 — Ground photo showing Integrated Plot Centre pin.

Figure 3.8 — Ground photo along the first transect line.

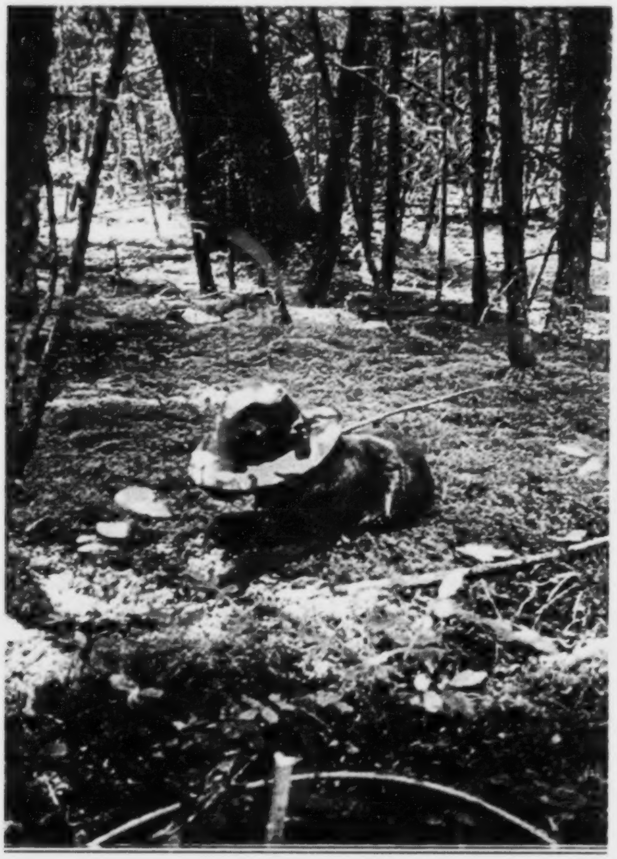


Figure 3.9 — Ground photo showing representative view.

3.3 Completing the Header Card (CH)

A Header Card (CH), must be completed for all samples. In addition, data must be recorded to identify each individual field card in case cards are separated. Some of the information is completed prior to sample establishment and some information during or as soon as possible after sample completion. In all cases the Header Card must be completed even if the sample was inaccessible and not completed.

Procedure

1. Record the following information on the Header (CH) card and all other field cards:

DATA ID	The Data ID (Project ID and Plot Sample #) must be recorded on all field cards (front and back), notes, sample collections, tree age cores, and so on.
PAGE — OF —	If the field cards provide inadequate space to record data, additional cards may be used as required.

2. The following information will be completed at another time:

FIELD CHECK BY	The full name of the person conducting a field check of the plot, and date of check. (This is not an Audit check.)
OFFICE CHECK BY	The full name of the person conducting the office check of the plot, and date of check.

3. Record the following information on the CH field card:

DATA ID	This section provides primary identification of the sample. The values are assigned prior to field sampling and provided to the field crew. Values may also be entered by the project supervisor prior to field sampling.
• **PROJECT ID**	The province has been divided into a number of inventory units. Record the code provided.
• **PLOT SAMPLE #**	Each sample is assigned a number. Record the number provided.
• **POLYGON IDENTIFIER**	A unique value is assigned to all NFI sample locations within the province. Enter the number provided. In most cases this number is not available at this time but will be entered at some future date.

PLOT TYPE	The plot type coding for monitoring samples consists of three characters as follows: Character 1 - type of sampling F = National Forest Inventory sample M = Management unit monitoring sample See Table 3.1 for field cards for each project type. Character 2 - intent of sample O = **O**riginal R = **Re**-measurement A = **A**udit M = **M**atching Character 3 - measurement number 1 = first measurement 2 = second measurement, and so on **Note:** Typical examples of coding are as follows: - FO1 = initial full National Forest Inventory sample
MEASUREMENT DATE	The date the sample measurements were initiated. Use this format:1999AUG12.
CREW INITIALS	Record crew members in order of responsibility for the work done, Person #1 is the crew leader. A record of crew initials (usually 3 initials as assigned) will be maintained by the MSRM, and if overlaps occur a numeric value may be added (for example, JSF1 and JSF2).
FIELD RESPONSIBILITY	Record the full first and last name of the person with primary responsibility for collection of each type of data (tree data and ecological data).
PLOT CLUSTER RECORD	This section provides a record of the information collected for a sample. Check Yes or No for the information completed for each plot.
• **INTEGRATED**	Check No if the sample was inaccessible or unsafe. In the Notes section, provide reasons the sample was dropped or suggestions for accessing or completing the sample.
• **RANGE, ECOLOGICAL, CWD**	Check the plots completed.
• **PHOTOS**	Record number of photos taken.

• **TYPICAL: TREES, ECOLOGY**	Check (Yes or No) to indicate if the tree data or ecological data are typical of the plot being sampled. For example, the Integrated Plot may be located in a wetland microsite within an upland forest and not typical of the plot being sampled, in the opinion of the crew. Note that in all cases the sample will not be moved.
NOTES	Enter any comments relevant to the sample measurements (such as photo notes, procedure problems).
PHOTO RECORD	Record the ground photos taken. If additional photos were collected, provide a short description with roll number and photo number. If no photos were taken, mark a "---" through both boxes and the reason photos were not taken.

Other Provincial Monitoring Ground Sample Programs

As indicated in Table 3.1, a complete set of field cards is required for the National Forest Inventory program. The opportunity to collect either more or less than this set of data is possible in the management unit monitoring program. Any modifications to the data collection protocols indicated here would need to be identified through the Project Implementation Plan (PIP).

Table 3.1 – Field cards for Ground Sample Types

Sample															
Type	**Code**	CH 1	CP 2	CL 3	RS 4	EW 6	EC 7	TD 8	TL 9	TS 10	EP 12	ED 13	ET 14	EH 15	EO 16
NFI - Full	F	X	X	X	X	X	X	X	X	X	X	X	X	X	X

3.4 Completing the Compass Card (CP)

The Compass Card (CP) provides an additional means of relocating samples in the short and long term (20 years or more).

Procedures

Complete a Compass Card(s) for each sample. Record as much information as possible. In addition to the Data ID, at a minimum record the following:

MAP NO. / POLYGON NO.	Forest cover map and temporary polygon numbers.
FLIGHT LINE / PHOTO NO.	Air photo numbers on which the tie point and sample are located. If Orthophotos were used exclusively, use "Orthophoto 1".
TIE POINT / REFERENCE POINT DETAILS	Record the Tie Point and Reference Point details, and offset Reference Pin where applicable. Record the Species, Diameter (DBH in cm), the azimuths and distances from the Tie Point Tree to Tie Point Location and Reference Point Tree to Reference Point Location. In some cases a tie point or reference tree will not be available. In these cases the crew could use a rock feature as a reference [record "ROC" in the species record] or any other identifiable feature such as telephone pole, hydro tower [record "OTH" in the species record and specify the feature in the comments section].
COMMENTS	Record any special features of the tree (e.g., major fork). Record other features of the Tie Point. If there is no Tie Point Tree, describe the Tie Point (e.g., junction of Loss Creek Main and Branch 300; northeast corner of Cutblock 11 on Branch 302; northwesterly edge of snow slide track).
GPS FILE ID	Record offset GPS reading, if applicable
STRAIGHT LINE BEARING AND DISTANCE TO IPC	Record the horizontal distance and azimuth from the Tie Point to the Integrated Plot Centre.
NAVIGATION NOTES	Map the features along the tie line. Record vegetation or timber type changes, creek locations (names, if known), rock bluffs, etc.
ACCESS POINT LOCATION	Record description. GPS file ID.

3.5 Completing the Cluster Layout (CL) Card)

A Cluster Layout card (CL) will be completed for all samples. The card provides a location to record detail on the features around the Integrated Plot Centre and the features associated with the sample.

Procedure

Record the following information on the CL field card:

GPS INTEGRATED PLOT CENTRE	Record the file number in the GPS Integrated Plot Centre field. Record offset GPS reading, if applicable. If a GPS reading was not available at the site record in the comments section why no data was collected. Record offset Integrated Plot Pin details, if applicable. **Recording the "intended" or target UTM co-ordinates:** **Field cards** – on the field card record the "intended" UTM co-ordinates in the comments section on the back of the CL card. **Handheld** – the handheld program will collect the "intended" UTM co-ordinates. **Final corrected GPS data must be entered before sample data is submitted to Resource Information Branch.**
SLOPE PROFILE	Sketch the cross section including Integrated Plot Centre which best describes the local topography.
INTEGRATED PLOT DETAILS	Map distinctive features within the plot such as water bodies, rock outcrops, site series boundaries, B.C. Land Cover classification boundaries.
SAMPLE CLUSTER DETAILS	Map distinctive features within the sample area which may aid in plot relocation, such as creek locations, road locations, polygon boundaries. Map the Reference Pin location and tie point location if it is close to the Integrated Plot Centre.
COMMENTS	Record any comments which may aid in relocation of the plot, or other items of interest.

4. Inventory Cruising

Introduction

This section deals with the identification and collection of detailed tree information from which volume can be calculated, quality can be assessed, and site potential can be determined. Trees are sampled using a combination of fixed-radius plots.

Objectives

- To collect attributes for the calculation of tree and stand volumes.
- To collect site index information.
- To assess and collect tree attributes for:
    future growth and yield assessment,
    wildlife,
    decay research
    forest health information.

General Procedures

Tree measurements are discussed in this section as they appear on the field cards, but the field crew is free to measure attributes in the most efficient sequence. Net factoring and call grading are discussed in a separate section. The steps are discussed in the following order:

1. Establish plot layout and identify (tag) trees to measure.
2. Identify and record tree attributes.
3. Assess and record wildlife use.
4. Record damage agent and severity codes.
5. Identify and record tree loss indicators.
6. Establish fixed-radius plot for small tree and stump data.
7. Classify and tally small trees by species.
8. Measure and record stump data.
9. Establish a fixed-radius plot for top height and quadrants for site tree measurements.
10. Determine leading species composition (by basal area) for the sample.
11. Select and record top height tree, leading, second species and other major species tree data.
12. Identify and record additional measurements on other major species, if required.

Field Cards for this Section

Tree Details (TD) (Appendix A, Figures A.10 and A.11)
Tree number, species, status, DBH, remaining bark, length, net factor, grades, stem map

Tree Loss Indicators (TL) (Appendix A, Figure A.12)
Damage agent, severity, loss indicators, location and frequency, and wildlife codes

Small Tree, Stump, and Site Tree Data (TS) (Appendix A, Figure A.13)
Small tree, stump, height and age information.

Detailed Procedures

4.1 Establishing Plot Layout

Sampling Method

The sampling design specifies the use of a series of fixed-radius plots for the sample.

Measuring Borderline Trees "In" and "Out"

It is important to accurately determine if the trees are 'in" or "out" of the appropriate fixed radius plot. The horizontal distance from the centre of the tree at "point of germination" to the IPC will be used to check this borderline distance.

4.2 Identifying and Recording Tree Attributes

Record the following measurements in the appropriate fields on the Tree Details (TD) field card. The fields to be recorded are listed and described below.

For the purposes of this inventory, a **tree** is defined as:

- a species identified as a tree for the purposes of this inventory. Refer to Appendix C: The National Forest Inventory Tree Code List;
- longer than 1.3 m, having roots attached to the bole or an identifiable root collar; and
- greater than or equal to 4.0 cm at DBH.

TREE NUMBER

All trees will be marked with numbered tags to identify them in the field and on the field cards. The plots will be re-measured in the future and are subject to audit cruising, and tagging the trees in a consistent sequence will enhance the chances of a successful remeasurement program. Trees will be tagged so that the plot will not be treated in a "special" manner by other visitors to the site.

Marking the Plot Circumference

1. Measure and mark the 5.64 metre and 11.28 metre plot radius around the IPC.

2. Carefully check the horizontal distance for trees close to the edge of the plot circumference. These trees are called borderline trees. Include borderline trees in the plot when at least half their base at the "point of germination" is inside the plot.

Dividing the Plot into Sectors

Divide the plot into 8 pie-shaped, 0.005 ha (45 degrees) tagging sectors. These tagging sectors are later combined into pairs in order to have 0.01 ha quadrants [site sectors] for the selection of site trees.

Sector 1 is always the first sector clockwise from due north. The additional sectors are numbered clockwise from sector 1.

Tagging Trees

Tag all living (standing and fallen) and dead (standing only) trees that have a DBH of 4.0 cm and greater within the 5.64 metre radius sub-plot, and trees with a DBH of 9.0 cm and greater between the 5.64 metre and 11.28 metre area. Use the pre-numbered aluminum tags provided in sets of 1 to 500. Do not duplicate tag numbers in a plot.

Tagging by Sectors

1. Start with sector 1. In this sector, affix the tags so that they face the **plot centre**. If the tag will be highly visible in this location move the tag around the tree at a height equivalent to high side until the tag is less visible.
2. Tag the trees near the plot centre first; then continue tagging outward by moving side-to-side across the pie-shaped sector. (see Figure 3.2)
3. As you reach the circumference of sector 1, make the last sideways pass in the direction of sector 2 so that the last tree tagged in sector 1 is as near as possible to the first tree tagged in sector 2.
4. In sector 2, affix the tags so that they face the **circumference** of the plot, away from plot centre.
5. Tag the trees near the circumference first, then continue tagging inward by moving side-to-side across the pie-shaped sector.
6. Make sure the last tree you tag in this sector is the one closest to the plot centre.
7. Repeat the procedures used in sectors 1 and 2 for the remaining sectors. Remember that tags in odd-numbered sectors face the plot centre while those in even-numbered sectors face the circumference (away from plot centre).

Attaching Tags to Trees

1. Determine the point at the base of the tree that is equal to the high side location. High side is defined as the highest point of mineral soil or a humus layer around the base of the tree, no lower than the point of germination. Nail the tag to the base of the tree as determined above:
    - use 6 cm aluminum nails;
    - drive the nail slightly upward so the tag hangs away from the tree;

- drive the nail into the trunk just enough to hold the tag securely and yet allow for radial growth.

Tagging Forked Trees

Special rules are required for tagging forked trees:

1. Tag the stem as a single tree if:
    - the fork occurs above 1.3 m, and
    - the stem has a dbh of at least 4 cm within the 5.64 metre sub-plot or has a dbh of at least 9.0 cm if the stem is between the 5.64 metre and 11.28 metre area.
2. Tag each stem separately if:
    - the fork occurs below 1.3 m, and
    - two or more of the fork's stems have a dbh of 4 cm or greater within the 5.64 metre sub-plot or have a dbh of at least 9.0 cm if the stems are between the 5.64 metre and 11.28 metre area. Use consecutive numbers when you tag these stems (tag the stem farthest to the left first and finish with the stem farthest to the right).
    - Locate the tag at high side ground level directly below the fork so it is evident which tag belongs to each stem.
3. Tag the stem as a single tree if:
    - the fork occurs below 1.3 m, and
    - only one of the fork's stems has a dbh of 4 cm or greater within the 5.64 metre sub-plot or has a dbh of at least 9.0 cm if the stem is between the 5.64 metre and 11.28 metre area.

Recording Tree Sector Numbers

All trees will have the sector number recorded to assist relocation at the time of re-measurement. The sector number will be recorded in the spare column (S1) on the right side of the TD field card.

TREE SPECIES

Assign a species code to all trees as recognized by The National Forest Inventory Tree Code List (Appendix C). This list is consistent with the VRI tree species list. The data custodian for the tree species list is the Director, Ministry of Forests Research Branch.

Note: It has been decided *not to measure* the willow "tree species" on the large tree or small tree plots. The ecological component will still collect data on these species.

Procedure

1. Record the tree number and a species code (up to 3-characters) for the tree being measured.
2. Code all species as accurately as possible using the National Forest Inventory Tree Code List (Appendix C). If the species cannot be identified with confidence, record the genus, if known. If the genus is not known, record the appropriate code for unknown species (such as Xc for an unknown conifer).

TREE STATUS

Assigning tree status allows for reporting trees in categories and reflects some potential for future growth.

Procedure

1. Record for each tree whether it is live or dead, standing or fallen.
2. Use the codes described in Table 4.1.

Table 4.1 – Tree Status Codes.

Code		Description
Live/Dead	**L**	**Live** trees have enough foliage to keep them alive (live cambium is present), and are rooted into the ground. Lack of foliage for some species, of course, is no indication of death during some seasons.
	D	**Dead** trees are obviously dead, or roots are separated from the ground and expected to die very shortly.
Standing/ Fallen	**S**	**Standing** trees are self supporting (that is, the tree would remain standing if all supporting materials were removed).
	F	**Fallen** trees are not self-supporting.

DIAMETER BREAST HEIGHT (DBH)

Measure and record the diameter of all live/dead, standing/fallen trees equal to or greater than 4.0 cm DBH.

Procedure

1. Determine high side ground level at the base of the tree, this is the height where the tag was placed.
2. High side is defined as the highest point of mineral soil or a humus layer around the base of the tree, no lower than the point of germination. Breast height is 1.3 m above high side measured parallel to the tree bole.
3. Measure the DBH in cm and tenths at 1.3 metres from the ground on the high side (Figure 4.1).
4. Use a stake marked at 1.3 m to accurately locate Breast Height on straight stems. On curved stems measure along the curve parallel to the centre of the tree. To ensure consistency with future measurements, crews should place the base of their DBH stake on the tree tag nail (where tags were placed at the level of high side ground) when determining the location to measure DBH.

5. Paint a dot on the tree, or mark a dot, where DBH was measured, preferably facing the plot centre. Marking may vary depending on land owner preferences.
6. Record the DBH with a tight diameter tape, outside the bark, making no allowance for missing bark.
7. If there is abnormal swelling or obstructions at DBH measure above and below the location and average the values as appropriate. This would be recorded as an estimated value.
8. Record whether the DBH was measured (M) or estimated (E).

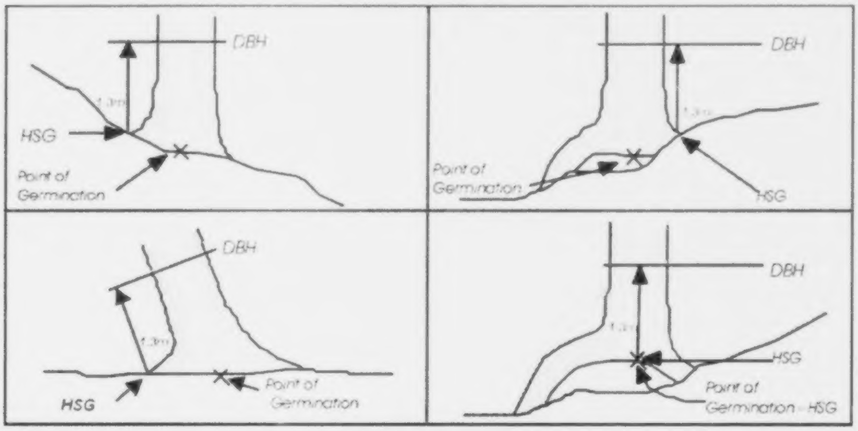


Figure 4.1 — DBH in relation to high side ground (HSG). (X indicates point of germination).

REMAINING BARK PERCENTAGE

The percentage of bark remaining is required to determine the actual wood volume of the tree. The impact on wood volume will be minor when small amounts of bark are missing, but could become significant when large areas of bark are missing, particularly on thick-barked species.

Procedure

1. For each DBH measurement, record the percentage of bark remaining at DBH to the nearest percent, for example:

bark: 100%	record as	- -
bark: 90%	record as	90
bark: 13%	record as	13
no bark present:	record as	00

Note: It does not matter if the diameter tape touches the exposed wood or not.

2. Calculate the bark remaining.

A simple way to obtain the percentage of bark remaining is to observe the length along the diameter tape where the bark is missing, and subtract to find the amount remaining. Calculate the percentage of bark remaining using the following formula:

$$\text{Remaining Bark \%} = \left(\frac{\text{Length of tape with bark}}{\text{Total length of tape}}\right) * 100\ \%$$

See Figure 4.2 for an example.

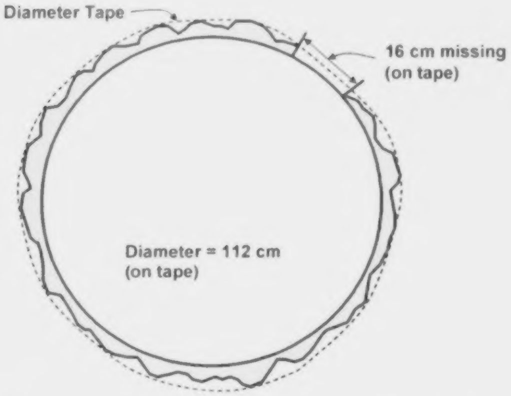


Figure 4.2 — Measurement of remaining bark.

EXAMPLE

On a 112.0 cm tree, bark is absent from 79 cm on the tape to 95 cm, a distance of 16 cm (95 – 79 = 16). The percent bark remaining is then calculated using the formula.

$$\text{Remaining Bark \%} = \left(\frac{\text{Length of tape with bark}}{\text{Total length of tape}}\right) * 100\ \%$$

$$\text{Remaining Bark \%} = \left(\frac{\text{Length of tape with bark}}{\text{Total length of tape}}\right) * 100\ \%$$

$$= \left(\frac{[112 - 16]}{112}\right) * 100\ \%$$

$$= \left(\frac{96}{112}\right) * 100\ \%$$

= 85.7% (Record 86%)

TREE LENGTH

Measure the length of each tree within the integrated plot, including broken and fallen trees.

Measure all trees except where the measurement is physically obstructed, it is unsafe to make the measurement, or when an accurate measurement is impossible. In such cases estimate the tree length.

For trees with broken tops, see discussion of Broken Tops below. For odd-shaped trees see Figure 4.3.

Procedure

1. Estimate the tree length before measuring as a check on your calculations.
2. Measure the length of the tree from the ground level on the high side along the stem to the top of the stem. Record length to the nearest 0.1 m.
3. For broken stems, measure the length that allows the most appropriate application of taper functions for calculating the volume of the tree.
4. For fallen, broken trees, record the length of the stem to the break. Measure the portion of the tree from the root collar to the top of the last connected portion (the pieces must be physically attached so that if one part is moved the next part will move).
5. Record whether the length was measured (M) or estimated (E).

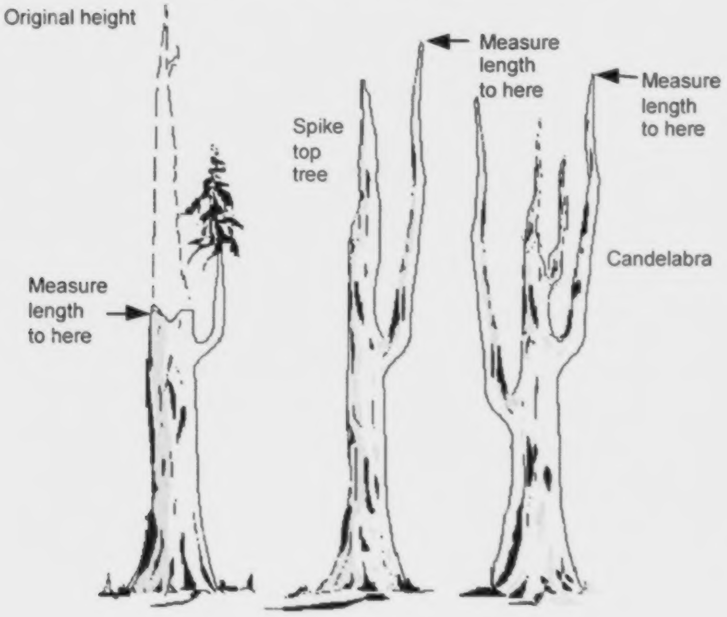


Figure 4.3 — Measurement of odd-shaped trees.

CROWN CLASS

Crown class is a ranking by crown position of a tree in relation to other trees in the immediate area surrounding the tree being measured. The crown class will be useful in future growth models.

Procedure

1. Assign a crown class code to all **standing live** trees using the descriptions in Table 4.2.
2. Dead trees and fallen live trees will **not** have a crown class assigned; mark a dash in the Crown Class box.
3. On trees with a broken or dead top assess the remaining live portion of the crown as to its present interception of light in the immediate area around the measured tree. For example, a tree was formerly in a dominant crown position but the top of the crown has died back and only the lower limbs are alive. This crown would most likely be ranked in the intermediate or suppressed position based on the current light interception of the remaining crown.

Table 4.2 – Crown class codes. .

Code	Description
D	**Dominant** Trees with crowns that extend above the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. They are somewhat taller than the codominant trees, and have well-developed crowns, which may be somewhat crowded on the sides, receiving full light from above and partly from the side.
C	**Codominant** Trees with crowns forming the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crown is generally smaller than those of the dominant trees and is usually more crowded on the sides, receiving full light from above and little from the sides.
I	**Intermediate** Trees with crowns below, but extending into, the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crowns are usually small and quite crowded on the sides, receiving little direct light from above but none from the sides.
S	**Suppressed** Trees with crowns entirely below the general level of the crown canopy (may include trees, shrubs or other obstructions) around the measured trees, receiving no direct light either from above or from the sides.

HEIGHT TO LIVE CROWN

Measure the height to the live crown for future research. *Height to live crown* is the distance along the bole from the high side ground level to the crown base. The crown base is normally the location on the stem where live branches occupy about three-quarters of the stem circumference. The primary objective is to estimate the "effective" extent of live crown for growth projections.

Procedure

1. Determine the crown base. If the definition of crown base is obviously not effective for the tree, then use your judgment as to the effective crown length. An example may be a tree that has no branches on one side.
2. Record the height to live crown for all live trees to the nearest metre.
3. Record two dashes (– –) for trees that are dead or have no effective crown (those having only a few green branches).

CLASSIFICATION OF RESIDUAL TREES

Classify all trees assessed on the large tree plot as to whether it is a residual from a former stand. In making this assessment, refer to the general area around the plot. Trees are classed as residual if they are present in even aged stands, are living remnants of a former stand, and occur as the occasional (< 25 per ha) large stem of an older age class than the stand as a whole. Typically these trees have larger diameters, a higher incidence or indications of decay, thicker bark, larger branching and "ragged" or flat tops. These trees must be clearly residual. Uneven-aged stands do not generally have residual trees.

Procedure

1. Determine if the tree is a residual as per the given definition.
2. In the spare column [S2 - column 56] record an "R" if the tree is a residual. If the tree is "not" a residual record a dash [-]. On the handheld data entry program enter a "R" immediately after the tree number in the "tree data" screen. The software assumes that a tree is not a residual "-" by default.

BROKEN TOPS

Measure all broken trees to the location of the break. For the compilation program to apply appropriate form factors to the tree stem, the diameter at the break point **OR** the original (projected) length of the tree must be recorded. If the broken top is available on the ground then a direct measure of diameter or actual "projected" height may be possible to measure.

Procedure

1. Measure the length of the tree stem to the break. For shattered stems, estimate the length after folding in shattered wood to make a whole diameter.

2. Record one of the following options, depending on which can be most reliably estimated:
    - diameter (cm) of the stem at the break
    - original unbroken height (m) of the tree

4.3 Assessing Tree Attributes for Wildlife

Trees can provide present or future habitat for the maintenance or enhancement of wildlife, including nest cavities and platforms, nurseries, dens, roosts, hunting perches, foraging sites, and display stations. Birds, mammals, amphibians, and various invertebrates use trees, and some species are highly dependent upon the specialized habitat provided by certain types of trees.

While knowledge of the size and abundance of live and dead trees permits an interpretation of the habitat suitability of a particular stand, specific wildlife-related data for each tree sampled is much more useful. A record of actual wildlife use of individual trees provides information on the preference of wildlife species for trees with certain characteristics.

All trees in the integrated plot will be assessed for the following attributes: visual appearance, crown condition, bark retention, wood condition, lichen loading, and wildlife use. These and other tree attributes, such as DBH, length, and percent sound, can be correlated to estimate wildlife habitat potential.

Procedure

1. Assess each tree in the 11.28m tree plot for wildlife attributes.
2. Record the appropriate codes on the Tree Details (TD) Card in the Wildlife Codes section.

VISUAL APPEARANCE

Classify the visual appearance and record the appropriate code (1 to 9) using the shape of the tree stem as the dominant characteristic (Figure 4.4).

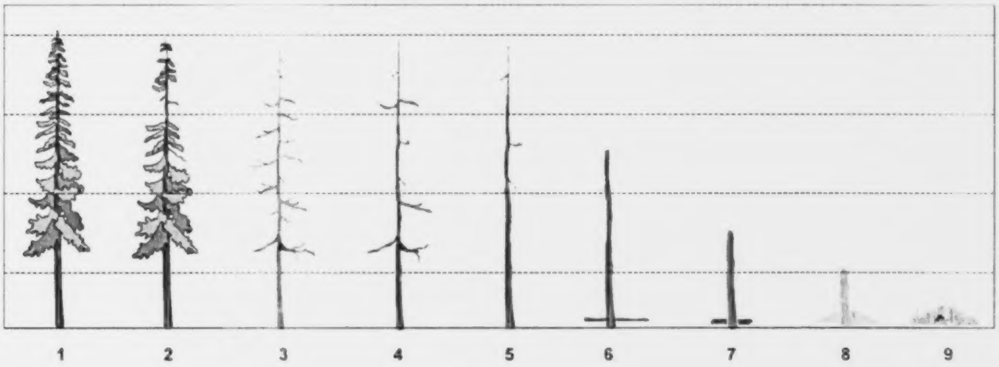


Figure 4.4 — Visuala ppearance codes.

CROWN CONDITION

Examine the crown in relation to a normal live crown (lower crown loss due to self pruning is not included). Record the appropriate code (1 to 7) from Table 4.3.

Table 4.3 – Crown condition codes.

Code	Description
1	All foliage, twigs, and branches present.
2	Some or all foliage lost, possibly some twigs lost, all branches usually present, possible broken top.
3	No foliage, up to 50% of twigs lost, most branches present, possible broken top.
4	No foliage or twigs, up to 50% of branches lost, top usually broken.
5	Most branches gone, some sound branch stubs remain, top broken.
6	No branches, some sound and rotting branch stubs, top broken.
7	No branches, minimum of rotting branch stubs, top broken.

BARK RETENTION

Classify the proportion of bark remaining, and code (1 to 7) from Table 4.4.

Table 4.4 – Bark retention codes.

Code	Description
1	All bark present.
2	Bark lost on damaged areas only (<5% lost).
3	Most bark present, bare patches, some bark may be loose (5%–25% lost).
4	Bare sections, firm and loose bark remains (26%–50% lost).
5	Most bark gone, firm and loose bark remains (51%–75% lost).
6	Trace of bark remains (76%–99% lost).
7	No bark (100% lost).

WOOD CONDITION

Classify the wood texture (soundness) of the tree, and code (1 to 8) from Table 4.5.

Table 4.5 – Wood condition codes.

Code	Description
1	**No decay**.
2	**Probable limited internal decay** and/or deformities.
3	**Limited decay**, wood essentially hard.
4	**Wood mostly hard** but decay spreading, soft wood present.
5	**Balance of hard and soft** wood, spongy sections.
6	**More soft** and spongy wood **than hard** wood.
7	**No more hard wood**, all soft or spongy, powdery sections.
8	**Hollow shell**, outer wood mostly hard or firm.

LICHEN LOADING

Assess all standing trees for lichen loading **on the branches** within 4.5 m of the ground or root collar.

Assign a rating from 0 to 5 based on comparison with the appropriate set of photos contained in *Estimating the Abundance of Arboreal Forage Lichens* (Armleder et al. 1992). A value of 0 indicates no lichens. If a tree has lichens, but none are below the 4.5 m mark, a rating of zero will be given.

WILDLIFE USE

Activity

Record wildlife use as a two-part alpha code. When indicators or wildlife use of sampled trees is observed, record the following codes in the first field: Feeding (F_); Open nesting (O_); Cavity nesting (C_); Marking (M_); Denning (D_); Perching (P_).

User

If you can determine whether usage is by a mammal (_M), bird (_B), reptile (_R), or amphibian (_A), record it as a second code letter.

For example, a feeding bird (FB), nesting amphibian (NA), denning mammal (DM).

If only the activity can be determined but not the responsible group, record only the first alpha code.

FEEDING (F __)

Feeding trees are very important to many wildlife tree users. Many woodpeckers feed on bark beetles; other birds glean insects from tree trunks, branches, and foliage; and hawks and eagles use trees as hunting and feeding perches.

Record if feeding behaviour or indicators are observed. Indicators might include the following:

1. Pileated Woodpeckers excavate large rectangular feeding holes
2. Red-breasted and Yellow-bellied Sapsuckers drill horizontal patterns of sapwells
3. Three-toed and Black-backed Woodpeckers scale off bark to feed on insects
4. Porcupines gnaw on large sections of bark (diagonal tooth marks are often apparent)
5. Rabbits, hares, and squirrels feed on the base of young trees (squarish "windows" or girdling at the base)
6. Squirrel cone caches or basal accumulations of cone bracts from squirrel feeding

NESTING (CAVITY NESTING C __ OR OPEN NESTING O__)

1. Record if evidence of cavity nesting (C __).

Cavity nests might be difficult to detect, but their locations are predictable to some extent. Many woodpeckers (including Three-toed, Black-backed, Hairy and Pileated Woodpeckers, and flickers) prefer live hardwoods as nesting trees and often excavate their cavity underneath branches. Nuthatches and chickadees build their nests in broken-off standing dead trees, or in broken branch holes, often directly below the breakage point where stem rots have entered the tree and softened the heartwood. Trees with cavity nests are important to retain because they may be used over many years by a variety of species. During the breeding season, the begging calls of nestlings are easy to detect.

Test a tree with a cavity nest by carefully and safely striking it to determine if the nest is occupied. If a wildlife species responds and can be identified, note the species presence in the *Comments* section using the specific species code (see User Species Codes below).

- Cavity nesters have perfectly round or oval nest holes
- Pileated Woodpecker and the Common Flicker have oval holes due to their large size
- Downy Woodpeckers, Chickadees and Nuthatches have small round holes
- Brown Creepers have hammock nests under the loose bark
- Some ducks, owls, and squirrels nest in abandoned woodpecker holes

2. Record if evidence of open nesting (O__).

Raptors and herons build large platform-style stick nests. Open nests of eagles, hawks, owls, and herons are usually situated in the upper part or crown of live and dead trees. Many of these nests are used by the same or different pairs over many years; therefore, nest trees for open nesters have a very high habitat value.

MARKING (M __)

Record evidence of marking, such as claw marks by grizzly or black bears, and antler rubbing by deer or elk. These trees are used mostly for communication of territorial boundaries and during courtship.

DENNING (D __)

Record evidence of denning by bears, squirrels, bats, or other mammals. Other mammals that use wildlife trees for denning include marten, fisher, weasels, skunks, and raccoons. Bears often hibernate in the hollow trunks of large standing trees, especially western red cedars. Entrances to tree dens can be basal or arboreal. Sometimes loggers discover dens while working; care should be taken not to destroy or injure the bears.

PERCHING (P __)

Perching and roosting trees are also essential habitat elements for wildlife tree users.

Characteristic perch trees of aerial foraging and hawking birds have prominent dead branches that provide a good view of the surrounding area. Perching use may be observed, particularly on tall trees with good vantage, especially near riparian edges. Plucking spots where raptors feed are especially important. They can be identified by "whitewash" and the remains of prey in the vicinity.

Roost trees are often in sheltered locations and have natural or excavated cavities. Roosts provide shelter from predators and inclement weather, some provide the environmental conditions appropriate for raising young. Roosting sites in trees include cavities, hollows, beneath bark, and in foliage.

NOTHING OBSERVED (– –)

Record if no wildlife use is evident or observed.

User Species Codes

If a positive identification can be made of species that are using wildlife trees in the plot, record the wildlife species codes in the comments section on the back of the Cluster Layout card. Record the common species name.

Use the 6-character species codes for wildlife species, found in the *Vertebrates of British Columbia: Scientific and common names,v . 2.0, 13 July 1998* available from the following web site: <http://www.elp.gov.bc.ca/wld/spi/taxonomy/index.htm>.

If a positive identification can be made: The first letter of the code identifies the species as mammal **(M)**, bird **(B)**, reptile **(R)** or amphibian **(A)**; the remaining 4 letters are from the first 2 letters each of the genus and species names, or of the common names in the case of birds.

For example:

M-LEAM	mammal, snowshoe hare (*Lepus americanus*)
B-BLGR	bird, Blue Grouse
R-THEL	reptile, western garter snake (*Thamnophis elegans*)
A-BUBO	amphibian, western toad (*Bufo boreas*)

If a positive identification cannot be made: Species groups begin with the 4-letter group code with the letter "U" followed by 3 letters derived from the common name of the species group.

For example:

B-UWOO	unidentified woodpecker
M-UMOU	unspecified mouse

4.4 Assessing Damage Agents and Severity

Note: The assessment of damage agents and loss indicators share some common elements but they are separate and distinct processes. Tree loss indicators are discussed in Section 4.5.

The National Forest Inventory will sample for damage agents and severity on individual trees to provide an assessment of forest health. The sample will identify the agent or agents that cause the damage and quantify severity of the damage. The data is recorded on the Tree Loss

Indicator (TL) field card. Damage agent types include abiotic, disease, insects, treatment injuries, and animal damage.

The damage agent and severity information can be used to determine:

- causes of tree mortality related to damage agents;
- stand growth reductions related to damage agents;
- species succession as related to damage agents;
- incidence and extent of the damage agent conditions;
- relationships between vegetation (forest) cover and damage agent conditions, used to derive a BEC forest cover hazard and risk rating;
- forest level yield projection and planning procedures (such as stratification of data by damage type, damage intensity, or damage risk class); and
- the relationship between damage agent and estimation of sound wood volume as determined through the net factoring and hidden defect processes.

Procedure

1. Assess damage agent(s) or conditions, and damage severity (ies) on all tagged trees, within the integrated plot.
   - Use the *Field Guide To Pests of Managed Forests in British Columbia* (Fink et al. 1989) to help identify damage agents and conditions. See Appendix D for damage agent codes, and Appendix E for damage severity and mortality condition codes and standards.
2. Record the damage agents for each tree on the Tree Loss Indicators (TL) Field Card.
   - Use a 1-, 2-, or 3-letter code, depending on your confidence in the identification. The damage agent codes are hierarchical and enable coding from very general (type or category) to specific (species). The first letter indicates the type of damage agent: abiotic (N), disease (D), insect (I), mites (M), treatment (T), and animal damage (A). The second and third letters indicate the specific agent, if it can be determined.
   - For example, Armillaria root disease is coded DRA (D = disease, R = root rot, A = Armillaria). If unable to identify the specific disease, only that it is a root disease, record DR. If you cannot determine that it is a root disease, but you are certain it is a disease (not an insect or other damage agent), record D for disease.
3. When the tree has more than two damage agents, list at least the most important two damage agents on the TL card. If you wish to list more than two damage agents repeat the tree number on successive rows.
4. Record the damage severity using the codes listed in Appendix E: Damage Severity and Mortality Condition Codes and Standards.
5. Record "O" (alpha character O) if no damage agent is observed.
6. Record "U" if the damage agent is not known. In many instances damage may be evident but the damage agent is not known.

4.5 Assessing Tree Loss Indicators

Specific loss indicators signify the potential presence of decayed wood. The loss indicators to be measured are: conks, blind conks, frost cracks, scars, forks, crooks, large rotten branches, dead tops, root rot, soundings, direct observation, and broken tops. The specific indicator, its extent, and frequency are recorded on the TL field card.

The inventory design for measurement and description of loss indicators attempts to adopt the traditional definitions and procedures of British Columbia and the Pacific Northwest wherever possible. The objective is to maintain a system that is compatible with current and past inventories, but will also meet future needs.

Procedure

1. Record loss indicators for all live trees (standing and fallen) within the Integrated Plot. It may be beneficial to collect the loss indicators on dead standing trees to assist with net factoring.
2. Enter the appropriate code for the loss indicator (see Table 4.6 for codes and description).
3. Enter a "+" if the location of the loss indicator is above high side ground level or "–" if below high side ground level.
4. Measure the position of each loss indicator on the stem of each numbered tree from ground level on the high side of the tree, to the nearest 0.1 m. Record the lower and upper extents as "From" – "To".
5. If an indicator is a point feature, such as a singular conk, record the location once under the "From" column with a frequency of "1".
6. If the indicator occurs more than once and is best described as a series, record the frequency as the number of times the loss indicator occurred in a particular interval.
7. If it is necessary to record more than three loss indicator occurrences, list the tree number as often as required on the TL card.
8. Record multiple occurrences of loss indicators which do not have common causes as separate occurrences. The intent is to localize the loss indicator (for example a tree with basal scars from logging and a scar in the upper crown from a rubbing tree stem would be entered as separate occurrences).

Note: Loss indicators are only recorded for the main stem on trees forked above DBH.

Table 4.6 – Loss indicator codes.

Code	Description
DD __	Unknown stem decay (conk) DDE is a known stem decay (*Echinodontium tinctorium*)
DR __	Unknown root decay DRA is a known root decay (*Armillaria ostoyae*)
BNK	Blind Conk
NGC	Frost Crack
SCA	Scar

FRK	Fork
CRO	Crook
LRB	Large Rotten Branch
DTP	Dead Top
BTP	Broken Top
SNG	Sounding
OTH	Other (cause is known, but no appropriate code)
DIR	Direct observation (decay or missing wood seen without cause observed)

LOSS INDICATOR – STEM DECAY (DD _) AND ROOT DISEASE (DR _)

Only specific root, butt, and heart-rot conks are considered to be loss indicators. Slash conks that occur on dead branches and wounds of living or dead trees are not considered as loss indicators. (Refer to Appendix D: Damage Agent Codes for stem decay and root disease conk codes.)

Stem Decays (Conks) Observed on Bole (DD _)

Conks refer to the fruiting bodies (sporophores) of stem decay fungi and are definite and reliable indicators of decay. Typically conks are thick, hard, woody-like perennial structures. Fruiting bodies can occur anywhere on the main stem and/or branches, but they appear most frequently around knots and on the underside of dead branch stubs and live branches.

Record the following:

1. The code for the species of conk
   - The loss indicator codes for conks are hierarchical. They are taken from the Forest Damage Agent and Condition Codes. The code identifies stem decay damage agents as DD_. The species of conk is then identified by the third letter. The codes for specific stem decays are shown in Appendix D.
2. Length to any single or isolated conk.
   - The frequency is 1.
3. If multiple conks occur in one section of the stem, record:
   - species of conk (should only be one species in each multiple occurrence)
   - length to the lowest in the series; length to the highest
   - frequency as to the number of conks in the series
   - if conk series are widely separated record as two series

Stem Decays (Root Rot) Observed on Roots or Ground (DR _)

Root Rot refers to fruiting bodies which are located on the roots and are associated with stem decay.

Typically fruiting bodies are short-lived, soft, and fragile. Often you may be able to see an indication of root rot decay directly on the roots.

Record the following:

1. The code for the species of root rot
    - The loss indicator codes for root rots are hierarchical. They are taken from the Forest Damage Agent and Condition Codes. The code identifies stem decay damage agents as DR_. The species of conk is then identified by the third letter. The codes for specific root rots are shown in Appendix D.
2. Length for any single or isolated root rot indicator is recorded as "0.0" (ground level).
    - The frequency is 1.
3. If multiple root rot indicators are observed, record:
    - species of root rot (should only be one species in each multiple occurrence)
    - length from "0.0" to "0.0"
    - frequency of indicators in the series

LOSS INDICATOR – BLIND CONK (BNK)

Blind conks are pronounced swellings or depressions around knots, usually caused by *P. pini* (DDP) on conifers, and *P. tremulae* (DDT) on aspen. Blind conks are definite indicators that decay is extensive in the tree stem.

Evidence of **conks** should be found in the surrounding stand before recording blind conk as an indicator.

Blind conks are identified as follows:

- stem swellings and stem depressions thought to be where the tree attempts to heal over decay emerging through a knot or branch stub.
- bright yellow to buff-coloured material found by chopping into basal branch stubs. This form is most often found in the interior of the province and crews will be directed by the project supervisor regarding procedures for chopping into trees.

Note: Verifying the existence of blind conk is the only situation where we allow crews to chop into live trees on the plot.

Record the following:

1. The loss indicator code BNK
2. For a single occurrence record:
    - the length to blind conk
    - the frequency as "1"
3. For multiple blind conks in one area of the stem, record:
    - length to the lowest; length to the highest
    - the frequency as the number in the series, including the lowest and highest

LOSS INDICATOR – FROST CRACK (NGC)

Frost cracks result from deep radial splitting of the trunk, caused by uneven expansion of moisture in the tree after a sudden and pronounced drop in temperature. The cracks usually originate at the base of the trunk and may extend many metres up the tree, following the longitudinal grain of the tree. The wound will often spiral up the tree following the movement of moisture.

Frost cracks are often reopened and extended by wind stresses or refreezing. Repeated healing of the cambium produces pronounced callous tissue, giving a ribbed appearance to the wound.

Record the following:

1. The loss indicator code NGC
2. For a single frost crack, record:
   - lowest extent (may be a negative value if it extends below ground on high-side)
   - the highest extent.
   - the frequency as "1"
3. For multiple frost cracks on one section of the stem, record:
   - lowest extent of the lowest frost crack in the series and highest extent of the highest frost crack in the series
   - frequency as to the number of frost cracks in the series

LOSS INDICATOR – SCAR (SCA)

A scar is an injury caused by external forces that damage the cambium or heartwood of the tree exposing the tree to wood decay fungi. A scar can occur anywhere on the main stem or root collar of the tree. Scars on branches or candelabras are not recorded.

A scar may be "open" meaning the wood is exposed, or "closed" meaning that the bark has grown over the injury.

Record the following:

1. The loss indicator code SCA
2. For an individual scar record:
   - lower extent of the scar (may be a negative number if it extends below ground on high side)
   - upper extent of the scar
   - the frequency as "1"
3. For multiple scars along one section of the stem, record:
   - lowest extent of the lowest scar in the series; highest extent of the highest scar
   - frequency of scars in the series

LOSS INDICATOR – FORK (FRK)

A fork is caused by damage to the leader of a tree that results in more than one branch (leaders) competing for apical dominance. The damage to the leader—from external forces, physiological factors, animals or insects (weevil) — exposes the stem to potential wood or decay fungi.

The following conditions are **not considered forks**:

- natural branching in deciduous trees
- small sharply angled branches or spikes, unless associated with a noticeable offset or diameter change at the location

- flattening of the tree tops caused by wind or physiological conditions where no terminal leaders are evident
- candelabra branches

If the secondary leader is visible, record the following:

1. Loss indicator code FRK (no minimum size limit)
2. Location of fork (the divergence of the stems); frequency as "1"
3. Distinct forks (record as separate occurrences)
4. Multiple forks within a reasonable range and a probable common cause (record upper and lower occurrence and number observed)

LOSS INDICATOR – CROOK (CRO)

A crook is caused by damage (mechanical, physiological, animal or insect attack) to the leader of a tree. Crooks potentially expose the wood to decay fungi.

To be recorded as a crook, it must meet the following conditions:

- The diameter of the main stem changes noticeably from the normal taper, and indicates that an injury has occurred.
- The stem must be offset severely enough to indicate that damage has occurred to the main stem.

Record the following:

1. Loss indicator code CRO
2. For a single occurrence, record
    - height of each individual crook
    - frequency as "1"
3. For multiple crooks in a section of the stem, record:
    - length to the lowest crook; length to the highest
    - frequency as the number of crooks

LOSS INDICATOR – LARGE ROTTEN BRANCH (LRB)

Large rotten branches are defined as those with a diameter inside the bark greater than 10 cm at the base. They have obvious signs of heart rot, and typically appear as short, rotten branches on overmature trees. They should not be confused with branches that have died through normal causes.

Record the following:

1. The loss indicator code LRB
2. For a singular occurrence, record:
    - the height to the central point of the branch
    - frequency as "1"
3. For multiple occurrences record:
    - the length to the central point of the lowest branch in the series

- the length to the central point of the highest branch
- the frequency as the number in the series (including the highest and lowest)

LOSS INDICATOR – DEAD TOP (DTP)

A dead top can be caused by any number of external injuries, physiological stresses, insects, or diseases. The top should be obviously dead with no green needles or leaves present.

Record the following:

1. The loss indicator code DTP
2. Length to the base of the dead top (top of live crown), length to the top of the tree; frequency as "1"

LOSS INDICATOR- BROKEN TOP (BTP)

A broken top is the product of an external force or condition resulting in the top of the tree breaking away from the main bole.

Broken tops can be caused by a variety of causes: wind breakage, snow damage, mechanical damage from other falling trees, and so on.

Record the following:

1. The loss indicator code BTP
2. The length to the break (estimate by folding back any jagged parts of the stem to form a complete stem); frequency as "1"

LOSS INDICATOR – SOUNDING (SNG)

Every tree on every plot is sounded. Sounding the tree involves striking the bole near the base of the tree with a blunt instrument. A hollow sound indicates a large amount of potential rot. If the tree sounds hollow it must be bored to confirm the presence or absence of decay.

Record the following:

1. The loss indicator code "SNG" whenever the tree "sounds" hollow. If subsequent boring indicates no decay or decay is present, the "SNG" loss indicator code is left on the field card. Record in the comments section that no decay was found.
2. Frequency and length are not recorded

LOSS INDICATOR – OTHER (OTH)

Sometimes rot or missing wood can be observed directly, and the cause is **known**. However, there is no appropriate loss indicator code.

Examples of "Other" may be hollow trees, butt rot, or sap rot on a live tree. In all these examples the cause is **known**.

Record the following:

1. Loss indicator code OTH

- In the Comments, state the reason for the loss

2. Location and frequency, if appropriate

Note: If this type of loss occurs frequently an appropriate code will be assigned in the future.

LOSS INDICATOR – DIRECT OBSERVATION (DIR)

Sometimes rot or missing wood can be observed directly, but the cause is **not** known.

An example of "Direct Observation" may be hollow trees where the cause is **unknown**.

Record the following:

1. Loss indicator code DIR
   - Make a comment in the Comments section if you think it is appropriate to do so.
2. Location and frequency, if appropriate

Note: If this type of loss occurs frequently an appropriate code will be assigned in the future.

4.6 Stem Mapping

Three trees in the Integrated Plot will be stem mapped to aid relocation of the IPC pin. **The stem map data is recorded on the TL field card.**

Procedure

1. Select three suitable trees at various aspects around the plot centre.
2. Insert an aluminium nail at the centre of the tree on the side of the tree (nail is placed at a 90° angle to the line from the tree to the plot pin). Measure and record the azimuth (nearest degree) and distance (.01m) from the Plot Centre Pin to the nail.

Note: In some locations there may be no tagged trees within the plot. If trees are present that are less than the minimum diameter for tagging the largest stems can be tagged and measurements would be taken from these stems. If only stumps are available then tag the appropriate stumps and take measurements from these stumps or a combination of small trees and stumps as required. In some instances, with no trees or stumps available, rocks or other features may be used to facilitate relocating the IPC. Record any abnormal situations in the comments section.

4.7 Measuring Small Trees and Stumps

Small Trees

A 2.50 m fixed-radius small-tree plot will be established at all Integrated Plot locations. The purpose of this plot is to determine relative numbers of small diameter live trees that are not sampled in the main tree plot. Measurements are recorded on the TS field card.

Procedure

1. At the Integrated Plot Centre establish a 2.50 m fixed-radius plot. The edge of this plot may be marked temporarily to ensure accurate measurements.
2. Count the live trees, less than 4.0 cm DBH and taller than 30 cm. Record the total number by species and by length class. Small trees must have their point of germination within the fixed plot radii to be measured as "in" trees.

Note: The dot tally columns on the field card are provided for your convenience in recording. Sum the data by classes and record the totals on the field card.

Example of small tree tally

Species	**Length**	
	31 cm to 1.3 m	**> 1.3 m but < 4.0 cm @ DBH**
Cw	2	1
Hw	6	0
Fdc	1	3
Dr	11	1

Plots with Clumps of Trees or Sucker Growth from Stumps

In some instances, particularly with deciduous species, clumps of stems originating from a common root system or stump that is vegetatively alive are encountered. Some or all of these stems could potentially grow into trees at some time in the future. The sampling intent is to identify the stems which express apical dominance to the best *judgment* of the field crew.

Procedure

1. Count the number of stems that appear to express apical dominance. The intent is not to examine each stem in detail but to arrive at a reasonable assessment of numbers within each class.

Stumps

The National Forest Inventory is attempting to sample the biomass of above-ground vegetation both living and dead. This includes measuring the biomass in self-supporting stumps in the 2.5 m fixed-radius plot on the integrated plot. Stumps are defined as being less than or equal to 1.3m in length and 4.0 cm top diameter inside bark or greater. The centre of the stump must lie within the plot (Figure 4.5). Only stumps which are vegetatively dead are recorded.

Treat stumps with roots detached from the ground as "coarse woody debris."

Procedure

1. Select stumps to tally in the 2.5 m plot. Stump must be 4.0 cm top diameter inside bark with the germination point of the stump inside the plot boundary.

2. In a clockwise direction from the north, record the following information for all stumps 4.0 cm or greater:

   - Species — to the level that can be determined by the field crew.
   - Frequency of stumps — usually "1", but if numerous stumps are in the plot (such as after spacing) record them by groups with the same characteristics.
   - Average diameter inside the bark.
   - Length to nearest 0.1 m (must be less than 1.3 m).
   - Estimate the percent sound wood for the stump.
   - Wildlife codes

     bark retention code

     wood texture
   - Wildlife use

     enter appropriate code(s) if wildlife use observed
   - Root rot species

     if root rot is present, record the damage agent code (if no root rot is found, then record three dashes).

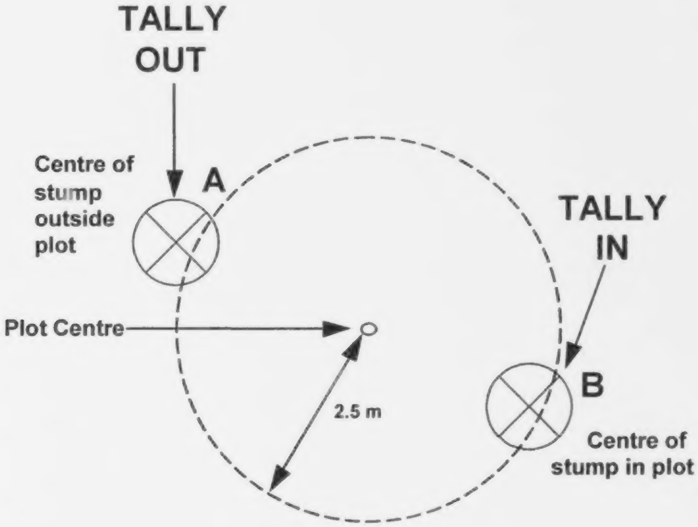
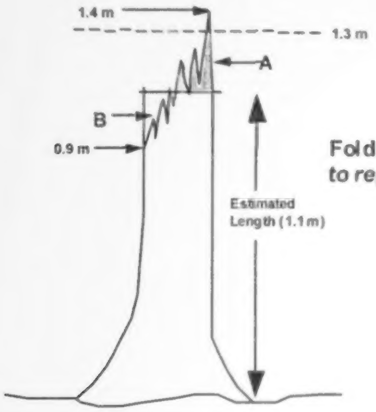


Figure 4.5 — Measurement of "in" and "out" stumps.

3. To measure the length of broken stumps, visually fold down the broken sections to compensate for the missing parts. Level out the wood on the cross section as you view it from the side to determine stem length (Figure 4.6). A similar process is used for broken tree length measurements.



Fold down the volume A
to replace the missing volume B

Figure 4.6 — Measuring height of broken stumps.

4.8 Recording Age/Height [Length] Tree Data

Age/height tree data is recorded on the Small Tree, Stump, and Site Tree Data (TS) card.

Objective

Age/height trees are measured to determine age and height for the major species by basal area in the sample and to determine site index.

General Procedures

The following types of trees are measured for age and height (length):

Standard selection types:

· Top height	(Type = **T**)	largest DBH tree in the 0.01 ha plot measure within a 5.64 metre radius of the plot center, regardless of species
· Leading species	(Type = **L**)	largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of leading species by basal area
· Second species	(Type = **S**)	largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of second species having more than 20% of the basal area in the plot
· Other major species	(Type = O)	Largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of all species, other than the leading or second leading species, having more than 20 % of the basal area in the plot.
· Residual Tree	(Type = V)	Select one "representative" residual tree (V tree) from the 11.28 metre plot if present.

The leading species, second species and other major species are determined from the basal area of the **live** trees (excluding residuals) equal to or greater than 4.0 cm DBH tallied at the Integrated Plot within the 5.64 and the 11.28 metre plots. The number of stems less than 9cm is weighted as these stems are only collected in the 5.64m plot. The tree species with the greatest basal area is the leading species, similarly the species with the second largest basal area is the second leading species. On fixed radius plots collected on electronic field data recorders the basal area calculations are performed within the program. When paper field cards are used an excel spreadsheet and a paper worksheet have been produced to calculate the basal area of all species in the field (see Appendix J - Calculating Basal areas in the Field).

The following criteria are used to select **T** trees:

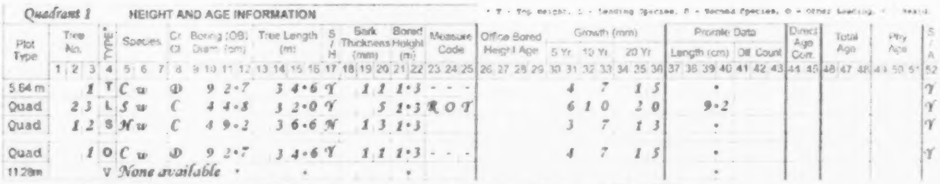
- within the 0.01 ha plot (within 5.64 m radius from plot centre)
- largest DBH tree
- must be alive
- dominant or co-dominant
- of any tree species

The following criteria are used to select L, S and O trees

- within the 0.01 ha quadrant (north-east, south-east, south-west or north-west quadrants)
- largest DBH tree of L, S or O tree species
- must be alive
- dominant or co-dominant
- **not a residual of a former stand**

If any potential **T**, **L**, or **S** tree meets the above criteria, the age and height **must** be measured and recorded. The following figure shows how the information is recorded (Fig. 4.7).

Note: The field cards have not been updated to the format shown below. Field crews will need to modify the cards as necessary (e.g. write in correct plot type, etc). Separate field cards should be used for each quadrant..



Quadrant 1 HEIGHT AND AGE INFORMATION

* T - Top Height, L - Leading Species, S - Second Species, O = Other Leading, V - Resid.

Plot Type	Tree No.	TYPE*	Species	Cr Cl	Boring (OB) Diam (cm)	True Length (m)	S / H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 Yr	Growth (mm) 10 Yr	Growth (mm) 20 Yr	Pronote Data Length (cm)	Pronote Data Off Count	Direct Age Corr.	Total Age	Phy Age	S / A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	C w	D	9 2•7	3 4•6	Y	1 1	1•3	- - -		4	7	1 5	•					Y
Quad	2 3	L	S w	C	4 4•8	3 2•0	Y	5	1•3	R O T		6	1 0	2 0	9•2					Y
Quad	1 2	S	H w	C	4 9•2	3 6•6	N	1 3	1•3			3	7	1 3	•					Y
Quad	1	O	C w	D	9 2•7	3 4•6	Y	1 1	1•3	- - -		4	7	1 5	•					Y
11.28m		V	None available	•		•			•						•					

Figure 4.7: Recording of Height and Age Information on the TS card

Non-standard selection type X:

- **X** extra (Type = X) an alternate tree outside 0.01 ha plot

These **additional** trees may be selected in a non-standard manner at the discretion of the field crew. This flexibility is provided for special cases where the field crew feels that adequate information cannot be provided following the standard procedure alone. For example, the sample is located in a patch of recently killed trees or a tree is unsafe to measure. For this to be of any practical use, comments must be supplied to explain why the tree was selected.

Suitability of Age and Height

A tree may meet the above selection criteria and still not provide a suitable age and/or height for site determination. **The age and height are still recorded in these instances with an "N" placed in the appropriate column.** An explanation must be given in the comments section as to why the age and/or height are not suitable.

The S/H (suitable for height) and S/A (suitable for age) columns are to be filled out for all T, L, S, O, X, and V trees selected. These columns indicate whether the age or height is suitable to be used in compiling age, height and site index for the sample. In these columns, a "Y" means the item is suitable and an "N" means it is not suitable.

The age and height data may also be used for special purposes, such as ecological correlation studies. These studies may require additional screening for tree suitability. The screening will rely on the physiological age values, age prorate information and additional crew comments to screen trees with rot or suppression or other damage.

Examples of reasons for a tree not being suitable for height:

- significant broken top (projected length is recorded in the comments for broken top trees)
- significant dead top
- fork or crook that significantly affects height growth
- abnormally high amount of scarring or other damage that may have affected height growth [for example - significant mistletoe infection]

Note: *Significant* refers to a reduction in the length of the tree compared to what it would be if undamaged. The reduction is great enough that a reliable site index estimate could not be obtained from the tree measurements.

The only reason for a tree not being suitable for age (for Top Height trees only):

- residual (see the following definition)]

  Trees are classed as residual if they are present in even aged stands, are living remnants of a former stand, and occur as the occasional (< 25 per ha) large stem of an older age class than the stand as a whole. Typically these trees have larger diameters, a higher incidence or indications of decay, thicker bark, larger branching and "ragged" or flat tops. These trees must be clearly residual. Uneven-aged stands do not generally have residual trees.

Note: By definition for NFI plots, L, S, and O trees cannot be residuals, so these trees must have a suitable for age code of "Y". The representative residual tree (V) must have a suitable for age code of "N". This may seem counter intuitive, but is required for the compilation program which was derived from the VRI compilation program. Top Height (T) trees and alternate trees outside the plot (X) are the only site trees that can have a suitable for age code of "Y" or "N". X trees are taken as alternates to the T, L, S, O, or V trees, and thus the suitable for age column for X trees must follow the convention for the type of site tree it is representing.

Procedure for Selecting Top Height, Leading Species, and Second Species Trees

The procedure outlined in this section describes the methods used to select and measure age/height trees.

1. Complete the measurements at the Integrated Plot using standard procedures.
2. Determine the leading, second, and other major species by basal area for the sample.
3. Establish a 0.01 hectare plot (5.64 m radius) at the IPC and the four 0.01 ha quadrants.
4. Select age / height trees in the 0.01 ha plot and/or quadrant as follows:
   (a) at the IPC:
      - largest DBH, live, dominant or co-dominant tree regardless of species (**T** tree)

   (b) within each quadrant
      - largest DBH, live, dominant or co-dominant tree of leading species (**L** tree)
      - largest DBH, live, dominant or co-dominant tree of second species (**S** tree)
      - largest DBH, live, dominant or co-dominant tree of all other major species (O tree)

   (c) within the sample
      - if residual tree(s) are present select one "representative" residual tree (V tree)
5. Select additional dominant and co-dominant trees (if applicable)
   - extra tree outside 0.01 plot (X tree)
6. Measure and record tree height for each selected tree.
   - Measure and record the length of the tree along the stem from high side ground. If the tree is broken off, measure and record the length to the break
   - determine suitability for height and enter code in S/H column [Yes or No]. If the height is "not suitable" record in the comments the factor(s) which make the height "not suitable" and if possible estimate a projected height.
7. Measure age and radial increment for each selected tree.
   - determine suitability for age for the Top Height (T) tree and enter "Y" or "N" in the S/A column. Leading (L), Second Species (S) and Other Leading (O) trees in the sample must have a "Y" entered for suitable for age. The Extra tree (X) must follow the convention of the site tree type it is representing, and the Residual tree (V) must have a suitable for age of "N".

Measuring Height, Age, and Growth Information

Age is used to determine the site index and projected rate of growth.

In each Integrated Plot a top height tree, up to four leading species trees, up to four second species trees, up to four each of other major species, and one residual if present will be bored to determine age.

Procedure for Measuring Age on Bored Trees

1. Bore the tree at Breast Height facing plot centre, if possible. If Breast Height cannot be bored conveniently, record the height of boring; corrections will be made later.
2. Determine the age by a ring count from an increment borer core, if possible, and enter the data in the **field age count** section on the tally card. The count will be the number of full rings. It is up to the field crew to determine when diameter growth has essentially stopped for the season.
3. The pith should be included in sample tree cores as often as possible to ensure accuracy, particularly in stands less than 80 years old. If you can get within a few years of the pith (relative to the tree age) and can confidently estimate the remainder, there is no need to re-bore the tree. Record the actual age counted on the increment borer core at the level where the tree was bored. Adjustments for years to reach that point will be done in the office compilation.
4. On large trees, or trees that have rotten centers, record the code for rot, age of the sound portion, and the length of sound core. The computer will calculate an age using these measurements. Be careful to measure only inside bark length along the core.

Note: Age relationships can also be derived from actual stump counts if working near felled road rights-of-way or logged areas.

5. Collect all tree cores in labeled "straws".
    - It is the crew's responsibility to accurately record field age data. The initial determination will be made in the field and for National Forest Inventory (NFI) samples, the age will be confirmed in the lab by Canadian Forest Service staff. Other monitoring samples should have ages microscope counted and the age entered in the office bored height age field.
    - Record at least the following on labels attached to the straws: Project #, Sample Number, Plot (for example, IPC), tree type (T, L, S, O, X, or V) and tree number (for example, Project CMI4, Sample 27, IPC, TH, Tree #3).

For National Forest Inventory samples, detailed instructions for the handling, storage and shipment of tree age cores is documented in Appendix L.

Procedure for Direct Measurement of Small Tree Ages

1. Count the whorls for the entire tree and add one to calculate the age of the tree.
    - Record bored height as 0.0 m
    - Enter the code WHO
    - Record the age in the Total Age field
2. Rather than damaging a small tree on the plot, select a tree of similar apparent age from outside the plot. This would frequently happen with trees of less than 2m in length. The

replacement tree should be outside the 11.28m fixed-radius plot, if possible. Determine the Breast Height age by cutting or boring.
- Enter the code OUT
- Record the length and diameter for the originally selected top height tree, but record the age from the tree selected from outside the plot.
- If the replacement tree does not reach breast height, it is recommended that the whorl count method be used on the original sample tree inside the plot.

Procedure for Direct Measurement of Age Correction on Large Trees

1. Where a tree can be safely bored at 1.3m and an accurate age correction determined from whorl counts, use the following method.
   - Record bored height as 1.3 m
   - Enter the code WHO
   - Enter the number of rings from the increment core on the field bored height age (and later office bored height age) column.
   - Count the whorls below 1.3m and add one year. Enter this number in the direct age correction field.
   - Record the combined age in the Total Age field

Procedure for Measuring Radial Increments

1. Make radial increment measurements on all trees counted for age.
2. Bore on the side facing the plot centre, at Breast Height if possible. Use the same core that was used for age determination if possible.
3. When it is not practical to take the increment in this direction, take it at two points at right angles on the bole of the tree (at the same height as the age boring) and average them.
4. Record the radial increment (in mm) for 5, 10, and 20 years.

Procedure for Measuring Physiological Age

The collection of physiological age information is "optional" for monitoring projects. Individual projects may collect the information if a need is determined.

1. If a sample tree for age measurement was suppressed in its early years, record the unsuppressed (physiological) age as calculated for that tree. The intent is to give an age that would be typical for the tree size if the tree had not undergone unusual suppression (or, more rarely, unusual growth).
2. Determine the physiological age as follows:
   - Enter the PHY code to indicate that a physiological age is used. The computer will calculate the age for you if you have not entered the age yourself.
   - For small trees, where you can interpolate accurately across the suppressed section, simply count "equivalent" rings.
   - For larger trees, particularly where centre sections are missing, leave the boring height age blank, and:

Count the number of years along the section closest to the bark. As with small trees, account for any clearly atypical growth sections by interpolation.

Enter the length of the core over which you have counted the partial age. The computer will use this data to calculate the "missing rings."

If you have a good estimate of the tree age it would also be useful to have that in the notes section.

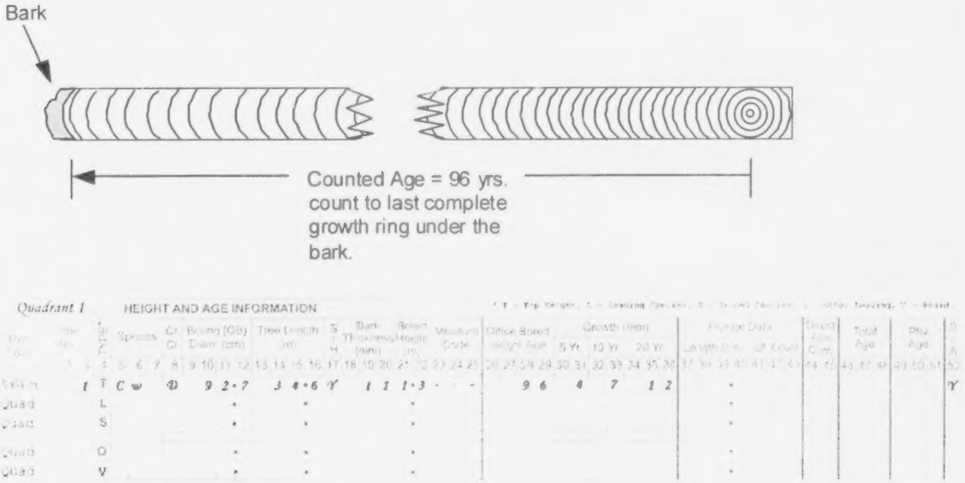
Recording Height, Age, and Growth Information

See Section 4.2, "Identifying and Recording Tree Attributes," for a complete description of codes. The following details are recorded on the TS field card:

Tree No.	Tree number as recorded in tree measurement plot.
Type	T = top height tree, L = leading species, S = second species, O = other major species tree, V = residual tree, X = additional tree.
Species	Tree species code.
Crown Class (C.Cl.)	Record crown class code (D, C, I, S).
Boring (OB) Diameter (cm)	Diameter outside bark at location of increment boring.
Tree Length (m)	Measured length of the tree to 0.1 m.
Suitable Height	Record a "Y" for "yes" if the tree height has not been significantly affected and is suitable for calculating a reliable site index estimate. Record a "N" for "no" of the tree height has been significantly affected.
Bored Height (m)	Height (above high side ground level) where boring was made.
Measure Code	If the crew did not physically measure to the pith, this code indicates the reason. Acceptable codes are:
	ROT = Core of tree rotten or missing.
	WHO = Total age determined from whorl count rather than boring.
	CRC = Increment borer cannot reach centre (tree too large).
	OUT = Age and radial increments determined from similar tree outside of plot, all other measurements for the tree within the plot.
	PHY = Physiological age is recorded or calculated on that tree. Usually due to atypical growth ring patterns.
Field Age Count	Repeat the Tree No. For each type, and record the actual age (number of rings) at boring height in the lower-left corner of the card.
Office Bored height Age	Increment cores are recounted in the office under magnification. Enter the recounted age in this data field.
Growth (mm)	Growth for last 5, 10, and 20 years.
Prorate Data	When a full boring is not possible record the actual measurements.
• **Length (cm)**	Length of increment core, from outer edge inward, upon which the ring count was made.
• **Ring Count**	Actual or representative count of tree rings along that core length.
Direct Age Correction	Number of full years of tree growth below the boring height, if it can be determined directly on that tree.
Physiological Age	Physiological age at the bored height determined by the crew. Record PHY in "Measure Code" field. It is not always necessary to enter this information. Optional for monitoring projects.
Suitable Age	If a top height tree is residual then record a "N" for not suitable, otherwise record a "Y". All other site trees in the sample must have a "Y" entered for suitable for height, with the exception of the X tree which must follow the convention of the site tree type it is representing, and the "V" tree which must have a suitable for age of "N".

Examples of Recording Age Information

1. Normal tree where the increment borer can reach the tree pith (enter --- in the Measure Code field)


Bark
Counted Age = 96 yrs. count to last complete growth ring under the bark.

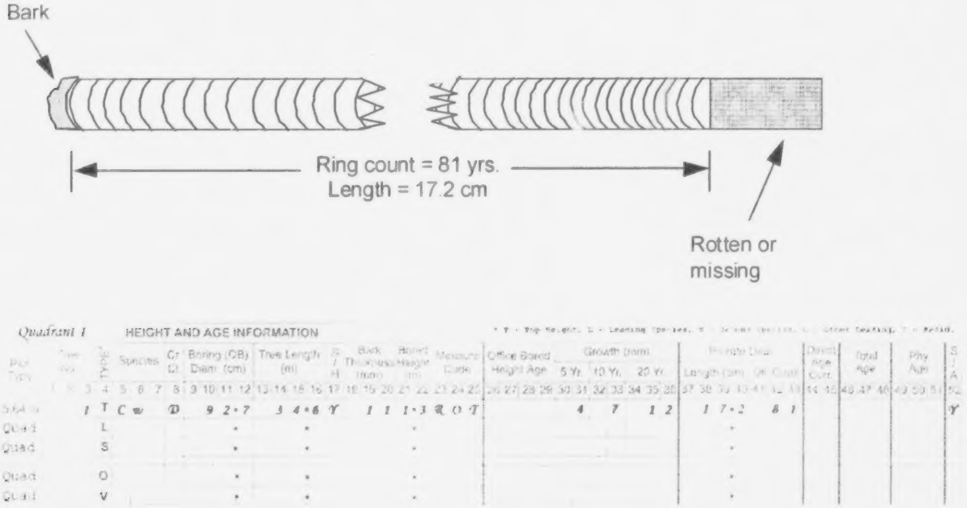
Quadrant 1 HEIGHT AND AGE INFORMATION

* T = Top Height, L = Leading Species, S = Second Species, O = Other Leading, V = [illegible]

Plot Type	Tree No.	TYPE*	Species	Cr Cl	Boring (OB) Diam (cm)	Tree Length (m)	S/H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 Yr	Growth (mm) 10 Yr	Growth (mm) 20 Yr	Pro-rate Data Length (cm)	Pro-rate Data OR Count	Direct Age Corr.	Total Age	Phy Age	S/A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	Cw	D	92.7	34.6	Y	11	1.3	---	96	4	7	12	.					Y
Quad		L			.	.			.						.					
Quad		S			.	.			.						.					
Quad		O			.	.			.						.					
Quad		V			.	.			.						.					

Figure 4.8— Recording age for full boring.

2. Tree with rotten or missing core (ROT)



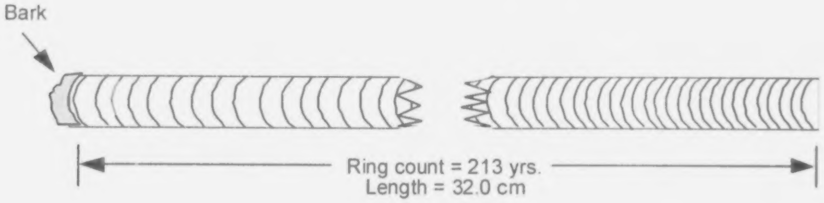
Quadrant 1 HEIGHT AND AGE INFORMATION

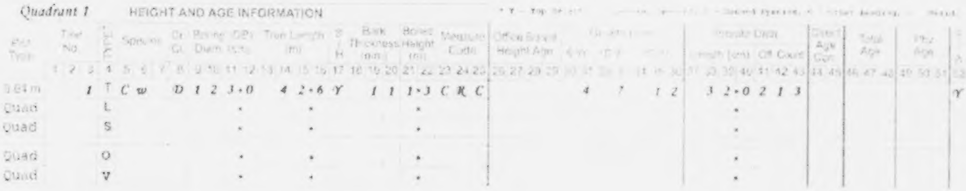
* T = Top Height, L = Leading Species, S = Second Species, O = Other Leading, V = [illegible]

Plot Type	Tree No.	TYPE*	Species	Cr Cl	Boring (OB) Diam (cm)	Tree Length (m)	S/H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 Yr	Growth (mm) 10 Yr	Growth (mm) 20 Yr	Pro-rate Data Length (cm)	Pro-rate Data OR Count	Direct Age Corr.	Total Age	Phy Age	S/A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	Cw	D	92.7	34.6	Y	11	1.3	ROT		4	7	12	17.2	81				Y
Quad		L			.	.			.						.					
Quad		S			.	.			.						.					
Quad		O			.	.			.						.					
Quad		V			.	.			.						.					

Figure 4.9 — Recording age for tree with missing core (ROT).

3. Trees where increment borer cannot reach centre of the tree (CRC)





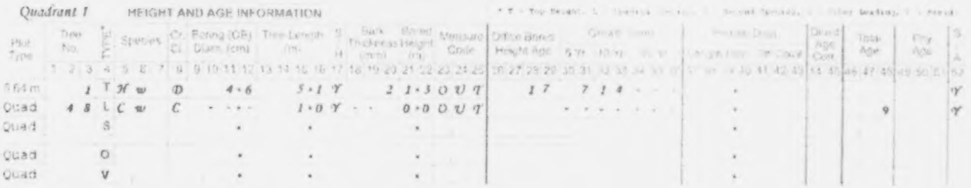
Quadrant 1 HEIGHT AND AGE INFORMATION

Plot Type	Tree No.	TYPE	Species	Cr. Cl.	Boring (OB) Diam. (cm)	Tree Length (m)	S / H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 yr	10 yr	20 yr	Prorate Data Length (cm)	Off Count	Bored Age Corr.	Total Age	Phy Age	S / A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	Cw	D	123·0	42·6	Y	11	1·3	CRC		4	7	12	32·0	213				Y
Quad		L			·	·			·						·					
Quad		S			·	·			·						·					
Quad		O			·	·			·						·					
Quad		V			·	·			·						·					

Figure 4.10 — Recording for partial boring (CRC)

4. Out-of-plot tree taken for sample age (OUT)

If the selected sample trees are too small to be bored without damaging the tree, or the length of the plot trees is less than 2 m, a representative tree of the same species from outside the 11.28 m radius plot can be cut down and counted, or bored. The preference in young stands (less than 2 m in height) would be to count the age as close as practical to the ground.

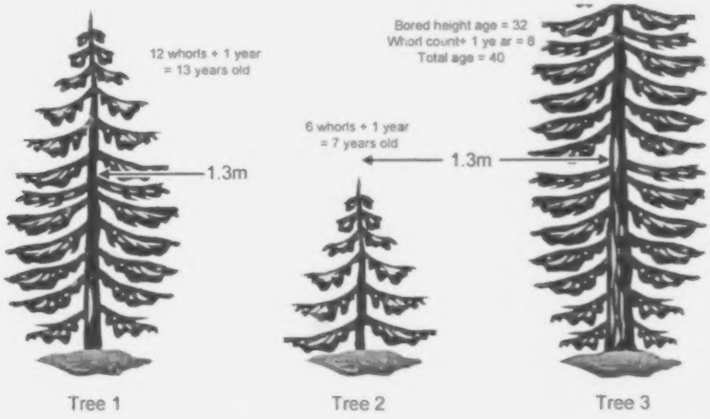


Quadrant 1 HEIGHT AND AGE INFORMATION

Plot Type	Tree No.	TYPE	Species	Cr. Cl.	Boring (OB) Diam. (cm)	Tree Length (m)	S / H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 yr	10 yr	20 yr	Prorate Data Length (cm)	Off Count	Bored Age Corr.	Total Age	Phy Age	S / A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	Hw	D	4·6	5·1	Y	2	1·3	OUT	17	7	14	- - -	·					Y
Quad	48	L	Cw	C	- - · -	1·0	Y	- -	0·0	OUT		- -	- -	- - -	·			9		Y
Quad		S			·	·			·						·					
Quad		O			·	·			·						·					
Quad		V			·	·			·						·					

Figure 4.11 — Recording age for out-of-plot-tree.

5. Tree age determined directly from count of branch whorls (WHO)



Quadrant I HEIGHT AND AGE INFORMATION

* T = Top Height, L = Leading Species, S = Second Species, [illegible]

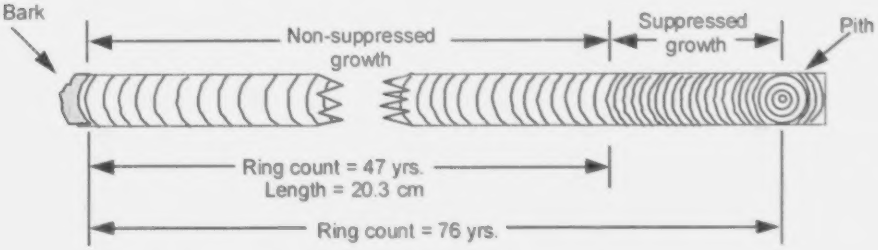
Plot Type	Tree No.	TYPE*	Species	Cr Cl	Boring (CB) Diam (cm)	Tree Length (m)	S/H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth Years 5 Yr	10 Yr	20 Yr	Length (cm)	Whorl Age Count	Total Age	Phy Age	S/A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40 41 42 43	44 45	46 47 48	49 50 51	52
5.64m	1	T	Sw	C	4.6	2.6	Y	1	0.0	WHO					.		13		Y
Quad	2	L	Hw	C	—	1.1	Y	—	0.0	WHO					.		7		Y
Quad	3	S	Cw	D	18.5	22.4	Y	8	1.3	WHO	32	14	25	59	.	8	40		Y
Quad		O			.	.			.						.				
Quad		V			.	.			.						.				

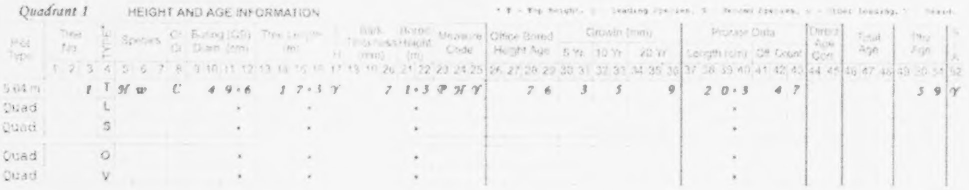
Figure 4.12 — Recording age using whorl count.

6. Physiological Age Measurement (code as PHY)

Calculation of physiological age:

1. non-suppressed growth rate (47 years ÷ 20.0 cm = 2.35 years/cm)
2. physiological age (2.35 years/cm X 25.0 cm = 59 years)





Quadrant 1 HEIGHT AND AGE INFORMATION

Plot Type	Tree No.	TYPE*	Species	Cr Cl	Boring (OB) Diam (cm)	Tree Length (m)	H	Bark Thickness (mm)	Boring Height (m)	Measure Code	Office Bored Height Age	Growth (mm) 5 Yr	Growth (mm) 10 Yr	Growth (mm) 20 Yr	Prorate Data Length (cm)	Prorate Data Count	Direct Age Corr	Total Age	Phy Age	S A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	Hw	C	49.6	17.3	Y	7	1.3	PHY	76	3	5	9	20.3	47			59	Y
Quad		L			.	.			.						.					
Quad		S			.	.			.						.					
Quad		O			.	.			.						.					
Quad		V			.	.			.						.					

Figure 4.13 — Recording physiological age.

Literature Cited

Armleder, Harold M., Susan K. Stevenson, and Stephen D. Walker. 1992. Estimating the Abundance of Arboreal Forage Lichens. Land Management Handbook Field Guide Insert 7. B.C. Ministry of Forests.

Fink, K. E., P. Humphreys, and G. Hawkins. 1989. Field Guide To Pests of Managed Forests in British Columbia. B.C. Ministry of Forests, Victoria, B.C. FRDA Publication 16, ISSN 0843-4719.

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5. Net Factoring

Introduction

This section outlines the steps needed to assess the net volume of trees on the Integrated Sample Plot.

Call grading and *net factoring* are processes used to assess timber quality and net tree volume. They are applied to the tree as the cruiser sees it. No attempt is made to predict grade based on falling breakage or any manufacturing process, or to predict volume loss without direct evidence. The two processes are related but will be presented separately for presentation ease.

The National Forest Inventory will employ the same Net Factoring procedures as developed for the Vegetation Resources Inventory.

Objectives

To provide a rule-based estimate of net tree volume.

Definitions

Net Factoring involves estimating the net volume of sound wood (gross volume less decay) of variable log lengths. These net volumes are based on: (1) direct measurements (includes visual estimates and physical measurements); or (2) standard, rule-based deductions associated with loss indicators.

The net factoring process is based on *only* making allowances for decay on consistently measurable or detectable features. Some trees will contain decay but will not have any visible symptoms.

Pencil bucking is the imaginary sectioning of trees into potential logs.

General Procedures

- Standard rule-based deductions will be used to determine the extent of the defect and the calculation of the net factor (% sound wood).
- Pencil bucking is used to identify grade changes in a tree and to localize where the net factor is applied. Pencil bucking is the imaginary sectioning of trees into potential logs.
- Net factoring is for sound wood loss only (decay or missing wood). No additional deductions are made for anticipated breakage, manufacturing loss, or splits and fractures.
- When calculating log volumes the diameter of the log will be the DBH, when dealing with the bottom log, or will be estimated at the midpoint of the log when dealing with upper sections of the tree. This may be slightly different than with some of the scaling conventions.

Field Cards for this Section

Tree Details (TD) (Appendix A, Figures A.10 and A.11)
log grades, lengths, % sound

Tree Loss Indicators (TL) (Appendix A, Figure A.12)
damage agent, severity, loss indicator, location, frequency

Detailed Procedures

5.1 Net Factoring Procedures

All trees in the Integrated Plot will have net factors calculated for each log.

1. Complete the tree loss indicators information prior to the net factor process.
2. In conjunction with the grading rules, determine the applicable log lengths for each tree.
3. Using measurements and rule-based deductions, calculate the net factor for each log section.
4. Where loss indicators are located on the tree below high side ground or extend below high side ground, consider the application as if the indicator was in the first log length. For example, a frost crack that extends from minus 0.5 m to plus 1.5 m is calculated as a 2 m frost crack with losses applied to the first log. Similarly a root rot conk present on the ground is applied to the first log length.
5. Measure all net factor calculations from high side ground.
6. Since net factoring is a priority when major defects exist it is desirable that the defect be isolated as a log. If this process creates an unrealistic description of the tree, incorporate the defect into a longer log.
7. Assign a net factor to each log. If the log has no major defects, and you detect no measurable sound wood loss, the net factor is 100%, recorded as two dashes (- -).

Net factors will only be recorded where:

- a conk, frost crack, or blind conk is present
- decayed or missing wood is visible (note – broken tops, dead tops, forks and other loss indicators can not have net factor deductions applied unless rot is visible).
- sounding of the stem indicates decay, and subsequent boring provides a relative decay ratio
- root rot is observed

5.2 Calculating Volume

In assessing the percent deduction of a log, you will need to calculate volumes. Logs are considered cylindrical, and depending on the type of defect, the decayed portion is considered to be rectangular (such as scars), cylindrical (such as conks), or conical (such as butt rot). The following conventions and formulas shown in Table 5.1 will be used in the calculations.

Diameter: length of a straight line passing through the centre of a circle.

Radius: line extending from the centre of a circle to the circumference (½ diameter).

L = length; W = width; D = depth; R = radius; $\pi = 3.14$ (to 2 decimal places).

Table 5.1 – Formula for calculating volume.

Shape	**Formula**
Rectangular solid	Volume = L * W * D
Cylinder	Volume = $\pi R^2 * L$
Cone	Volume = $(1/3) \pi R^2 * L$
Units must be consistent (all cm or all m).	

5.3 Applying Deduction Rules

Table 5.2 – Summary of procedures for determining net factor for loss indicators.

Defect	Form	Method	Deduction area	% Sound of Deduction Area	Grade
1. Heart Rot Conk (DD_)	Cylindrical	Rule	4 m above conk 6 m below conk	50%	Y
2. Root rot (DR_)	Conical	Rule	3 m	81%	assigned*
3. Blind Conk (BNK)	Cylindrical	Rule	4 m above conk 6 m below conk	50%	Y
4. Frost crack (NGC)	Other	Rule	extent of frost crack	calculated	assigned*
5. Scar (SCA)	Rectangular	Calculate	extent of scar	calculated	assigned*
6. Cat face (SCA)	Conical	Calculate	extent of scar	calculated	assigned*
7. Fork (FRK)	Other	Rule	if decay present: 1 m below	50%	Y
8. Crook (CRO)	Other	Rule	if decay present: 1 m below	50%	Y
9. Rotten branch (LRB)	Cylindrical	Rule	1 m above 1 m below	50%	Y
10. Dead top (DTP)	Other	Calculate	live crown to top of tree	calculated	assigned*
11. Broken top (BTP)	Other	Rule	broken off portion remaining stem 1.0 m of decay below break	00 00	N assigned*
12. Sounding (SNG)	Other	Calculate	various	calculated	assigned*
13. Direct Observation (DIR)	Other	Rules	various	calculated	assigned*
14. Other (OTH)	Other	Rules	various	calculated	assigned*
* Assigned by cruiser in the field					

1. HEART ROT CONK (DD _)

Inventory conventions assume that conk rot extends 4 m above the conk and 6 m below it. This is normally a 10 m Y grade log with a net factor of 50%.

For example, an H grade tree with a conk at 12 m could be graded “H” grade for 6 m, “Y” for 10 m (net factor 50%), then “H” grade again starting 4 m above the conk.

The rule for heart rot conk is as follows:

Table 5.3 – Deduction rule for Heart Rot Conk.

Form	Cylindrical
Method	Rule
Deduction area	4 m above conk; 6 m below
% Sound of deduction area (net factor)	50%
Grade	Y

For multiple conks, where the lengths between conks are less than the 10 m minimum, decay is assumed to extend 4 m above the top conk and 6 m below the lowest conk. The length is given a net factor of 50% and a grade of Y.

If you can measure more severe decay, pencil buck the affected portion and grade it a Y with a greater net factor. This is done in at least 1 m increments.

Note: Other major defects, such as frost cracks associated with conk, can be assumed to be cylindrical in nature as well, with the same net factor and grade.

---

2. ROOT ROT (DR_)

All root rots are assumed to be conical in nature. Unless otherwise observed, the inventory convention is that the cone of rot extends 3 m from the ground and that the ratio of the diameter of the rot to the diameter of the butt is 75% (¾).

The deduction (for the 3 m section) is a constant, with the net factor always equal to 81% for that section.

The rule for root rot is as follows:

Table 5.4 – Deduction rule for Root Rot.

Form	Conical
Method	Rule
Deduction area	0 — 3 m
% Sound of deduction area (net factor)	81%
Grade	Assigned

Formula

$$\text{Net Factor \%} = \left(\frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}}\right) * 100\ \%$$

Shortcut Formula

Since the relative size of the defect is constant, the decayed percentage for the first 3 m is a constant of 19%. The simple form of the equation is:

$$\text{Net Factor \%} = 100\% - \left\{19\% * \left[\frac{\text{length of decay}}{\text{log length}}\right]\right\}$$

EXAMPLE

Log length: 8 m; Rot extends: 3 m

Since the relative size of the defect is constant, the decayed percentage for the first 3 m is always 19%.

$$\begin{aligned}\text{Net Factor} &= 100\% - \left(19\% * \left[\frac{3}{8}\right]\right)\\ &= 100\%\text{-}(19\% * 0.35)\\ &= 100\% - 7\%\\ &= 93\%\end{aligned}$$

Figure 5.1 — Example of net factor calculation for Root Rot.

Note: Schweinitzii butt rot is listed in the Forest Health Damage codes (Appendix D) as a "stem rot" coded as DDS. If Schweinitzii butt rot is encountered the net factoring process will still apply the loss as a "root rot [0.6 metre deduction]". The loss indicator would be DR and noted in the comments as "Schweinitzii".

3. BLIND CONK (BNK)

Interior and transition zones: typically bright orange rot is visible when knots are cut open.

Coastal zone: typically excessive swelling of the bole or a collapsed bole.

The rule for blind conk is as follows:

Table 5.5 – Deduction rule for Blind Conk

Form	Cylindrical
Method	**Rule same as conk**
Deduction area	4 m above conk; 6 m below
% Sound of deduction area (net factor)	50%
Grade	Y

4. FROST CRACK (NGC)

The rule for frost crack is as follows:

Table 5.6 – Deduction rule for Frost Crack.

Form	Other
Method	Rule
Deduction area	Pencil buck at top and bottom of the series of frost cracks.
% Sound of deduction area (net factor)	Sum of frost crack length(s)/log length * 10%. Maximum deduction 40% (Net factor would be 60% sound).
Grade	Assigned

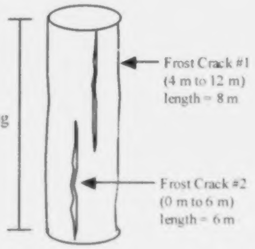
Note: Frost crack(s) that run across the grain of the log, may result in a lower grade. This would be due to the percent of merchantable lumber volume loss, rather than the percent of sound wood loss.

EXAMPLE

log length: 12 m;

Two frost cracks are located as follows: 6 m long (from 0 m to 6 m)
8 m long (from 4 m to 12 m)

$$\text{Deduction} = \left(\frac{\Sigma \text{ crack lengths}}{\text{log length}}\right) * 10\%$$



Calculation of Net Loss Factor

$$\text{Net Loss} = \left(\frac{\Sigma \text{ crack lengths}}{\text{log length}}\right) * 10\%$$

$$= \left(\frac{8+6}{12}\right) * 10\%$$

= 12% volume loss

Figure 5.2 — Example of net factor calculation for Frost Cracks.

5. SCAR (SCA)

The rule for scar is as follows:

Table 5.7 – Deduction rule for Scar.

Form	Rectangular
Method	Calculate
Deduction area	Extent of scar
% Sound of deduction area (net factor)	Calculated
Grade	Assigned

Indicator is **present** and rot or missing wood is **evident**.

Calculate the net factor using one of the following two methods, depending on whether or not the depth of rot can be measured.

Method 1: When depth of rot can be measured (for example, butt scars)

Assume the scar is rectangular:

$$\text{Volume of Decay} = \text{length} * \text{width} * \text{depth}$$

Assume the log is cylindrical (diameter DBH for butt logs, midpoint for other logs):

$$\text{Log volume} = \pi * \text{radius}^2 * \text{length}$$

Formula

$$\text{Net Factor \%} = \left(\frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}}\right) * 100\ \%$$

Note: To have a net factor less than 90% is rare for a scar.

EXAMPLE

log length: 10 m; diameter: 100 cm

scar: length 10 m, width 20 cm, depth 10 cm

1. **Volume of Decay** $= L * W * D$ (volume of rectangle)
   $= 10\ \text{m} * 0.2\ \text{m} * 0.1\ \text{m}$
   $= 0.2\ \text{m}^3$

2. **Volume of Log** $= \pi R^2 L$ (volume of cylinder)
   $= \pi * (0.5\ \text{m})^2 * 10\ \text{m}$
   $= 3.14 * 0.25\ \text{m}^2 * 10\ \text{m}$
   $= 7.8\ \text{m}^3$

3. **Net Factor** $= \left(\frac{7.8 - 0.2}{7.8}\right) * 100\%$
   $= \frac{7.6}{7.8} * 100\%$
   $= 97\%$

Figure 5.3 — Example of net factor calculation for Scar with known depth.

Method 2: When depth of rot cannot be measured

1. Estimate width and measure length of scar on log
2. Calculate circumference of log at the scar (π * D)
3. Calculate "decay length" deduction = $\frac{1}{2}\left(\frac{\text{width of scar}}{\text{circumference of log}}\right) * \text{scar length}$
4. Net Factor = $\left(\frac{\text{length of log} - \text{decay length}}{\text{length of log}}\right) * 100\%$

EXAMPLE

log length: 10 m; diameter: 60 cm; scar 6 m in length, 20 cm wide

Decay Length

$$= \frac{1}{2}\left(\frac{\text{width of scar}}{\text{circumference of log}}\right) * \text{scar length}$$

$$= \frac{1}{2}\left(\frac{20\text{cm}}{3.14 * 60\text{cm}}\right) * 6\text{m}$$

$$= 0.32 \text{ m}$$

Net Factor

$$= \left(\frac{\text{length of log} - \text{decay length}}{\text{length of log}}\right) * 100\%$$

$$= \left(\frac{10\text{m} - 0.32\text{m}}{10\text{m}}\right) * 100\%$$

$$= 97\%$$

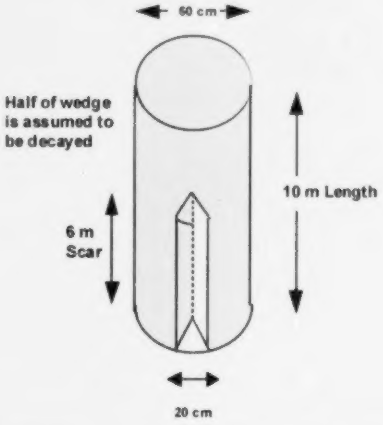


Figure 5.4 — Example of net factor calculation for Scar with unknown depth.

6. CAT FACE (SCA)

The rule for cat face is as follows:

Table 5.8 – Deduction rule for Cat Face.

Form	Cylindrical/Conical
Method	Calculate
Deduction area	Extent of Scar
% Sound of deduction area (net factor)	Calculated
Grade	Assigned

Cat face is a scar (SCA) or missing section of wood that allows measurement of decayed or missing wood.

There are two methods of dealing with this form of internal decay, depending on whether the associated heart rot is cylindrical or conical in nature, and that decision must be made by the cruiser on-site.

Method 1: Formula for Cylindrical Defect

$$\text{Net Factor \%} = \left(\frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}}\right) * 100\ \%$$

Shortcut Cylindrical Formula

$$\text{Net Factor \%} = \left[1 - \left(\frac{(\text{radius of decay})^2 * \left(\frac{\text{length of decay}}{\text{log length}}\right)}{(\text{radius of log})^2}\right)\right] * 100\%$$

EXAMPLE
Cylindrical Defect

Log length: 10 m; Cylindrical cat face for 6.0 m

Sound wood = 20 cm (solid outer ring of wood)

Diameter = 200 cm (radius = 100 cm [1.0 m])

$$\text{Net Factor} = \left[1 - \left(\frac{(0.80\text{m})^2 \bullet \left(\frac{6\text{m}}{10\text{m}}\right)}{(1.0\text{m})^2}\right)\right] \bullet 100\%$$

$$= [1 - (0.384)] * 100\%$$

$$= 62\%$$

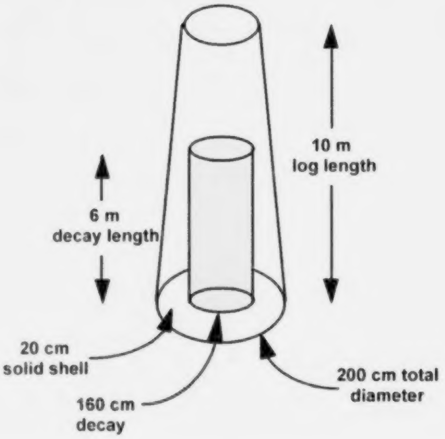


Figure 5.5 — Example of net factor calculation for Cat Face (cylindrical defect).

Method 2: Formula for Conical Defect

$$\text{Net Factor \%} = \left(\frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}}\right) * 100\ \%$$

Shortcut Conical Formula

$$\text{Net Factor \%} = \left[1 - \left(\frac{\left(\frac{1}{3}\right) * (\text{radius of decay})^2 * \left(\frac{\text{length of decay}}{\text{log length}}\right)}{(\text{radius of log})^2}\right)\right] * 100\%$$

EXAMPLE (Conical)
defect length not equal to log length

Conical cat face for **5.0** m of **8.0** m log

Sound wood 20 cm (solid outside radius, therefore 80 cm defective core)

Diameter = 200 cm (radius = 1.0 m)

$$\text{Net Factor} = \left[1 - \left(\frac{\left(\frac{1}{3}\right) * (0.8\text{m})^2 * \left(\frac{5\text{m}}{8\text{m}}\right)}{(1\text{m})^2}\right)\right] * 100\%$$

$$= \left[1 - \left(\frac{0.33 * 0.64 * 0.63}{1}\right)\right] * 100\%$$

$$= [1 - (0.13)] * 100\%$$

$$= 87\%$$

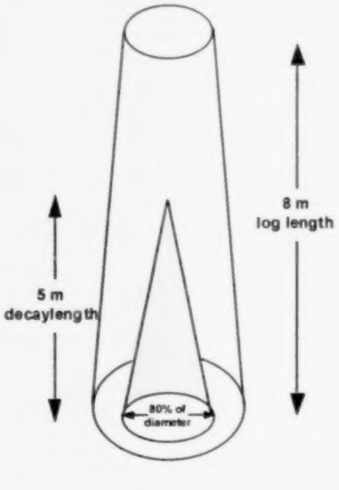


Figure 5.6 — Example of net factor calculation for Cat Face (conical depth).

Method 3: Uses table 5.9, butt rot guide for length deductions

1. Find the ratio $\left(\frac{\text{diameter of decay}}{\text{DBH}}\right)$

2. Use Butt Rot table for ratio of butt rot.

Note: to develop consistency in the net factoring process individuals should not interpret between the butt rot ratios. Determine the nearest ratio and apply the selected value.

---

3. Express length deduction as percentage of log length.

Another option of conical defect associated with butt rot is to use the butt rot guide for length deductions.

Butt rot is generally included with the log for its maximum grade length. However, if the rot lowers the grade of the butt log, take a short log (minimum 3 m) and assign a grade and net factor to that short log.

The Butt Rot Guide (Table 5.9) gives the conical butt rot ratios by log length. Note that the net factor may determine the grade, based on the percent lumber recovery or other grade requirements. Deductions and grade considerations are based on rot/DBH ratio. Calculate the ratio to the nearest ¼ diameter, determine the deduction from the table below, and reduce the log volume by the deduction.

Table 5.9 – Butt Rot guide for length deductions.

Ratio	**Length**	**Deduction**	**Grade Consideration***
¼ diameter	1.8–2.4 m	0.2 m	0.6 m
½ diameter	3.6–4.2 m	0.4 m	1.8 m
¾ diameter	5.4–6.0 m	1.2 m	3.6 m
4/4 diameter	7.2 m	2.4 m	4.2 m
*Grade consideration describes how much of a piece will not produce lumber.			

EXAMPLE

The butt rot length is not visible, therefore we need a process to determine deduction length.

Rot diameter = 55 cm; DBH = 102 cm; log length = 10 m

$$\text{Ratio} = \frac{\text{diameter of decay}}{\text{DBH}} = \frac{55}{102} = \text{approximately } \frac{1}{2}$$

Using the table, butt rot extends from 3.6 m to 4.2 m, and the deduction is 0.4 m length.

$$\text{Net Factor} = \left(\frac{10 - 0.4}{10}\right) * 100\,\%$$

$$= 96\%$$

Figure 5.7 — Example of net factor calculation for Cat Face (using butt rot table).

7. FORK (FRK)

In most cases, the position of the fork will signify a change of grade. If the fork is major, both in size and impact on grade, it may be pencil bucked out in 1 m lengths with a grade of Y assigned to that section and a net factor of 100%.

If decay is visible the rules for fork are as follows:

Table 5.10 – Deduction rule for Fork.

Form	Other
Method	Rule
Deduction area	1 m below
% Sound of deduction area (net factor)	50%
Grade	Y

8. CROOK (CRO)

In most cases, the position of the crook will signify a change of grade. If the position of the crook will result in a change of grade, both in size and impact on grade, it may be pencil bucked out in 1 m lengths with a grade of Y assigned to that section and a net factor of 100%.

If decay is visible the rules for crook are as follows:

Table 5.11 – Deduction rule for Crook.

Form	Other
Method	Rule
Deduction area	1 m below
% Sound of deduction area (net factor)	50%
Grade	Y

9. ROTTEN BRANCH (LRB)

Larger rotten branches/knots (≥ 10 cm inside bark) are a significant indicator of cylindrical rot.

The rule for rotten branches is as follows:

Table 5.12 – Deduction rule for Rotten Branch.

Form	Cylindrical
Method	Rule
Deduction area	1 m above the rotten branch; 1 m below
% Sound of deduction area (net factor)	50%
Grade	Y

Note: For multiple, overlapping rotten branches/knots (less than 2 m apart), deduction extends 1 m above and below the series.

10. DEAD TOPS (DTP)

(Broken tops are handled separately.)

Dead tops are usually associated with sap rot, but rot must be visible before a net factor can be applied.

The rule for dead tops is as follows:

Table 5.13 – Deduction rule for Dead Tops.

Form	Other
Method	Calculate
Deduction area	From top of live crown to tree length
% Sound of deduction area (net factor)	Calculated
Grade	Assigned

Note: Dry checked wood may affect grade, but will not affect the sound wood content (net factor).

Sap rot depth is to be estimated at the midpoint of the dead top.

Formula

$$\text{Net Factor \%} = \left(\frac{\text{volume of sound cone}}{\text{volume of cone}}\right) * 100\ \%$$

Shortcut Formula

$$\text{Net Factor \%} = \left(\frac{\text{radius of sound wood}}{\text{radius of log}}\right)^2 * 100\ \%$$

EXAMPLE

Midpoint diameter 20 cm (10 cm radius)

2 cm depth of sap rot (giving 8 cm radius of sound wood)

$$\text{Net Factor \%} = \left(\frac{8\text{cm}}{10\text{cm}}\right)^2 * 100\ \% = 64\%$$

Figure 5.8 — Example of net factor calculation for Dead Tops.

11. BROKEN (MISSING) TOPS (BTP)

The tree is graded and net factored normally to the broken top (pencil buck at the break). The missing portion is graded as "N" and net factored as "00" (no sound wood).

Table 5.14 – Deduction rule for Br ps.

Form	Other
Method	Rule
Deduction area	from break to original top
% Sound of deduction area	00 = no sound wood
Grade	N (nothing)

Broken tops, particularly on hemlock and balsam, are usually associated with rot, but rot must be observed on the stem (or broken top if it is on the ground nearby) before a net factor can be applied.

Rot associated with logs below the broken top is assumed to run 1 m below the break.

Table 5.15 – Deduction rule for Rot Associated with Broken Tops.

Form	Other
Method	Rule
Deduction area	1 m below the break
% Sound of deduction area (net factor)	00
Grade	Y

Formula

$$\text{Net Factor \%} = \left(\frac{\text{last log length} - 1.0\text{m}}{\text{last log length}}\right) * 100\ \%$$

EXAMPLE

Last log length is 10 m up to a broken top

$$\text{Net Factor \%} = \left(\frac{10\text{m} - 1.0\text{m}}{10\text{m}}\right) * 100\ \% = 90\%$$

Figure 5.9 — Example of net factor calculation for Broken Tops.

12. SOUNDING FOR DECAYED OR MISSING WOOD (SNG)

"Sound" all measured trees in the Integrated Plot. Only if the tree gives a hollow sound, bore the tree with an increment borer on the side facing the plot centre and record the loss indicator "SNG." Even if the boring does not reveal any decay, the "SNG" code is still left as recorded.

Decay discovered by boring will not be used for net factoring except in the case of sounded trees. For instance, discovering decay by boring a top height tree, which did not sound hollow, would not result in a deduction.

Measure the sound wood.

Determine the ratio of decay to tree DBH. If there are no other indicators, assume that the rot is conical in nature and apply the deduction in Table 5.9 Butt Rot Guide for Length Deductions.

13. DIRECT OBSERVATION (DIR)

Sometimes rot or missing wood can be observed directly without, but the cause is **not** known.

The rule for direct observation is as follows:

Table 5.16 – Deduction rule for Direct Observation.

Form	Other
Method	Rules
Deduction area	Various
% Sound of deduction area (net factor)	Calculated
Grade	Assigned

14. OTHER (OTH)

Sometimes rot or missing wood can be observed directly, and the cause is **known**. However, there is no appropriate loss indicator code.

The rule for Other is as follows:

Table 5.17 – Deduction rule for Other.

Form	Other
Method	Rules
Deduction area	Various
% Sound of deduction area (net factor)	Calculated
Grade	Assigned

15. MULTIPLE DEFECTS

In general, the assignment of net factors to trees with multiple defects is left to the professional judgment of the cruiser, based on the net factoring procedures discussed here.

However, several concepts should be noted:

- Net factors less than 50% will only occur with severe:
  - cylindrical butt rot
  - sap rot
  - missing wood
- Severe frost cracks/scars associated with conk on the lower bole can be assumed to be connected and treated as cylindrical rot, with a net factor of 50%.
- Sound sections 3 m or longer between defects can be treated as separate logs. Sound sections less than 3 m are incorporated with the log section above or below.

EXAMPLE
of isolated section between defects

Conk at 12 m and 24 m. This creates a 2 m section between the defect areas, so we can combine all three sections into one log.

Deduction length = $2 \times (6 + 4) = 20$ m

Log Length (from 6 m — 28 m) = 22 m

Conk Deduction 50% (of 20 m) = 10 m

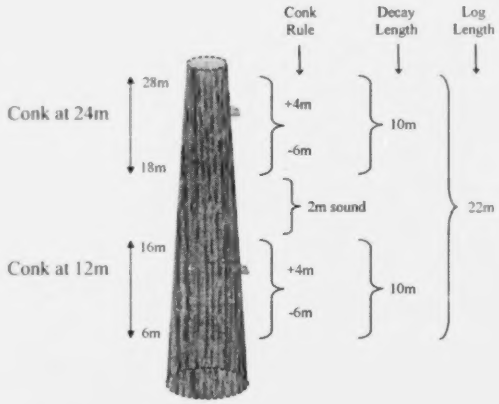
Grade (all 3 sections) = Y

Net Factor $= \left(\dfrac{\text{length of log} - \text{length of deduction}}{\text{length of log}}\right) * 100\ \%$

Net Factor $= \left(\dfrac{22\text{m} - 10\text{m}}{22\text{m}}\right) * 100\ \%$

= 54.5% Record as 55%

Note: The same procedure should be used whenever grade is assigned, particularly for butt rot and/or cat face.



Note: If the upper conk were at 25 m, it would create a 3 m log between the two defects. This log would be treated as a separate sound log with its own grade. This would create three separate logs, each with its own grade and net factor (a more detailed description of the tree).

Figure 5.10 — Example of isolated sections between defects.

6. Call Grading

Introduction

This section outlines the steps needed to assess the quality of measured trees. The call grading criteria and procedures as developed for the "Vegetation Resources Inventory" will be employed in the National Forest Inventory.

Objectives

To provide a rule-based estimate of tree quality.

Definitions

Call grading is the procedure used to assign one of the National Forest Inventory (NFI) grades (modified coastal log grades) to standing and fallen timber. Grading is a hierarchical process. The grade extends up the tree as long as the grade rules allow. When a knot or other defect is encountered or the diameter can no longer support that grade, the grade changes for the next portion of the tree.

Some trees are too small to meet the minimum log sizes for NFI grades. These small trees are assigned a small-tree grade developed for use in the NFI.

Variable lengthc all grading recognizes only a minimum length (see Section 6.1) and allows the cruiser to pencil buck (the imaginary sectioning of a portion of the tree) at grade changes rather than at predetermined log lengths.

General Procedures

- **The cruiser should be able to grade the log into at least the correct major category. The major categories are lumber, peeler, sawlog, shingle, and utility chipper.**
- NFI grades are assigned to logs based on size, quality, and soundwood recoverability.
- Grades are assigned using the hierarchy of NFI grades. Start at the first grade in the hierarchy. If the log cannot meet that grade, move to the next in the list until the grade can be met.
- A log is the highest grade it qualifies for within the hierarchy . It is not a choice of market preference, current harvesting practices, accessibility, or other factors.
- Grades are assigned to ALL trees within the integrated plot.
- Small trees are assigned a small tree grade developed for use in the National Forest Inventory.

Field Cards for this Section

Tree Details (TD) (Appendix A, Figures A.10 and A.11)
Log grades, lengths, % sound

Tree Loss Indicators (TL) (Appendix A, Figure A.12)
Damage agent, severity, loss indicator, location, frequency

Detailed Procedures

6.1 Call Grading Procedures

For Standing or Fallen Trees

1. Measure all log lengths from the high-side ground level.
2. Determine the highest grade the bottom log would satisfy, based on grading rules and characteristics of the minimum log lengths for that species.

Table 6.1 – Minimum log lengths (in m) by grade and species (highest grade at left).

Category	Lumber	Peeler	Sawlog	Shingle	Utility Chipper
GRADES	**[D,F,G]**	**[B,C]**	**[H I J]**	**[K L M]**	**[U X Y]**
Douglas-fir	5	5	5 4 5	-	5 3 1
Cedar	5	-	5 4 5	4	5 3 1
Hemlock	5	-	5 4 5	-	5 3 1
Balsam (*Abies*)	5	-	5 4 5	-	5 3 1
Spruce	4	-	4 4 4	-	5 3 1
Pine/Larch	5	-	5 4 5	-	5 3 1
Cypress/Yew	4	-	4 4 4	-	5 3 1
Deciduous	-	5	- 5 -	-	5 — 1

3. Add to that log in 1-metre increments until the top diameter of the log (measured as diameter inside bark [DIB]) or the log quality results in a grade change.

   Maintain that log grade as long as possible if the next grade would be a lower one in the hierarchy.

   Change the grade as soon as possible if the next log grade would be a higher one in the hierarchy.
4. Record the grade and the length. For example, an H grade 16 m log is "H 16".
5. Follow the same procedure for the next log up the tree.
6. The last grade on the tree will normally be carried to the top of the tree and "99" recorded (except when top of tree is broken off), regardless of utilization limits (applies to grades J, U, X, Y). Do not attempt to grade the top log based on top diameter or on the fact that it may be a short log due to utilization top diameter.
7. For grading in immature stands where the first log is a J and the quality of the remaining stem is similar, call the whole tree J (J99). Similarly for grades U, X, and Y.

8. If the tree has certain defects (such as excessive butt rot, fork, conk, rotten branches) you may want to isolate for grading those portions of the tree.

For Broken or Cut Stems

If the stem is over 1.3 m tall, grade and net factor it like any other tree up to the broken top. The missing or unconnected portion is always graded as "N-99-00".

For Small Trees

Trees that do not meet the minimum log size of 5 m to a 10 cm top diameter (U grade) are assigned a small tree grade developed for use in the National Forest Inventory. Assign a single grade to the entire tree, using the following codes:

P – **Pretty good**
– Straight and good form.
– Well spaced/distributed knots or branches.

Q – **Questionable**
– Slight sinuosity, minor crooks or deformities
– Small knots

R – **Reject**
– Major sinuosity or deformity.
– Large knots/uneven distribution of knots or branches

Note:

- For broken top trees, record the small tree grade to the break, and record "N-99-00" for the broken-off portion.
- Dead trees are assessed on their condition at the time of the survey. For example a dead tree with straight and good form with no checking could still be graded as a "P" grade. Trees with very minor checking could be "Q" grade if they meet the other grade criteria. Trees with moderate to severe checking should be graded as "R" grade.
- Trees that fall into the small tree category with conk or blind conk should be assigned an "R" grade, and net factors are as shown for heart rot below.

6.2 Grading Conventions and Guidelines

Conventions

- Trees with conk or blind conk will have the affected portion graded as "Y" grade.
- The last grade on the tree will normally be carried to the top of the tree and is coded as "99" regardless of utilization limits (this applies to J, U, X, Y and small tree grades).
- If the top of the tree is broken off (missing), the missing portion is graded as "N" (Nothing), length is assigned as "99", and net factored as "00" (0% sound wood).

Guidelines

1. HEART ROT

- Conk, blind conk, and rotten branches have specific lengths and grades applied.

Conk	Y	4 m above, 6 m below, 50% sound

Blind Conk	Y	4 m above, 6 m below, 50% sound (like conk)
Rotten Branch	Y	1 m above, 1 m below, 50% sound

- Scars

  Severe cylindrical cat face should be pencil bucked at the top of the cat face, with that length and net factor used to determine the grade.

2. BUTT ROT

- Butt rot is generally included with the log for its maximum grade length.
- Refer to the Butt Rot Guide for Length Deductions table. Note that the net factor may determine the grade, based on the % lumber recovery or other grade requirements. The table also provides a guide for "grade considerations," which is how much of the piece will not produce lumber.

Table 6.2 – Butt rot guide for length deductions.

Ratio	Length	Deduction	Grade Consideration*
¼ diameter	1.8–2.4 m	0.2 m	0.6 m
½ diameter	3.6–4.2 m	0.4 m	1.8 m
¾ diameter	5.4–6.0 m	1.2 m	3.6 m
4/4 diameter	7.2 m	2.4 m	4.2 m
*Grade consideration describes how much of a piece will not produce lumber.			

3. FROST CRACKS

- Pencil buck at the top of the frost crack(s) for log length.
- Assign a percentage loss (based on 10% per frost crack, if they run the length of the log) with a maximum total deduction of 40% (net factor of 60%).

Note: The angle, position, or net factor will determine the appropriate grade based on % lumber recovery and/or % merchantable.

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4. OCCASIONAL LARGER KNOTS (OLK)

All sawlog grades (H, I, J, U and X grades) can have occasional larger knots (OLK's). Occasional larger knots are allowed to the extent of one per 3 meters of log length [two per 3 meters for X grade logs over 50 centimeters top diameter] and must be located where knot sizes for portions of the logs are specified.

For example, if a grade requirement allows 4 cm knots over the entire log, then occasional larger knots can be anywhere on the log. Where the requirement allows larger knots on a portion of the log then the occasional larger knots must be within this portion only.

5. SUN CHECKS AND/OR INSECT DAMAGE

- A check is a separation of the wood, at right angles to the annular rings that runs through the heart of the log. There is no soundwood deduction for sun checks or insect damage.
- Grade considerations, particularly % lumber, are applied.
- No soundwood deduction for sun checks or insect damage.

Formula for Grade Consideration Calculation of Sound % Lumber

$$\%\ \text{Recovered} = \left(\frac{\pi r^2}{\pi R^2}\right) * 100\ \%$$

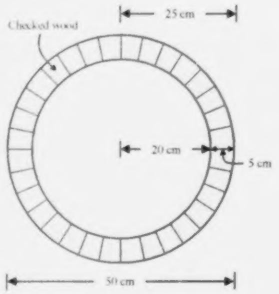
where r = radius of sawable lumber portion, and
R = radius of tree

EXAMPLE

Diameter = 50 cm; Radius of tree (R) = 25 cm; Sun check = 5 cm

Radius of sawable lumber portion (r) = 20 cm

Whole tree is sun checked



$$\% \text{ Recovered} = \left(\frac{\pi r^2}{\pi R^2}\right) * 100\ \%$$

$$= \left(\frac{r^2}{R^2}\right) * 100\ \%$$

$$= \left(\frac{20^2}{25^2}\right) * 100\ \% \quad \text{OR} \quad \left(\frac{40^2}{50^2}\right) * 100\ \%$$

(These give the same mathematical result.)

= 64% lumber recovery

The appropriate grade is X (J grade would require 75% lumber; U grade would require 66% lumber).

Figure 6.1 — Example of grade calculation for sun checked logs.

6. TWIST

- There is no soundwood deduction for twist.
- Grade considerations, however, are applied.
- The amount of twist is measured along 30 cm at the mid-point of the log. The percentage of twist is calculated by dividing this amount by the diameter at the top of the log. With the exception of J grade, there are maximums of both of these values, as shown below. Twist must be less than both of these restrictions. For example, a D grade must deviate by

no more than 6 cm over the 30 cm distance, and the deviation divided by the top diameter must be no more than 4%.

- The displacement of twist over 30 cm is also observed.
- Twist comprises two factors: percentage of top diameter; and maximum displacement over 30 cm. Table 6.3 shows the maximum values for specific grades. If the parameters are not met, the next lower grade applies.

Table 6.3 – Maximum twist displacement by grade.

Grades		% of top diameter	Maximum displacement (over 30 cm)
Lumber	D, F, G	4%	6 cm
Peeler	B, C	7%	8 cm
Sawlog	H	7%	8 cm
Sawlog	I	10%	9 cm
Sawlog	J	10%	No limit
Utility	U, X	13%	13 cm
Note: "Waterline to waterline" (180 degree twist) over 2 m is automatically Y grade.			

- If twist only appears on a portion of a tree – it should be pencil bucked out with the appropriate grade, length, and net factor applied.

EXAMPLE 1

Calculations

Estimated top DIB: 60 cm for log section
Severe twist 8 cm (along 30 cm section)

% twist = (8 cm twist)/(60 cm top) * 100% = 13%

This log is graded as U, since this is the first grade met in the hierarchy (other defects may lower the grade further).

EXAMPLE 2

Calculations

Estimated top DIB 25 cm for log section
Minor twist, 2 cm displacement

% twist = (2 cm twist)/(25 cm top) * 100% = 8%

This log is graded as J, since this is the first grade met in the hierarchy.

Figure 6.2 — Examples of grade calculation for twist.

7. CEDAR SHINGLE CRITERIA

Cedar will not be graded as a shingle if it can make a sawlog grade. If a log, due to heart rot or butt rot, has less than 75% soundwood, but meets slab thickness requirement for that grade, the log becomes shingle grade.

If logs are unsuitable for lumber manufacture due to, shape (heavy fluting), heart rot (less than 75 % lumber), or splits (creating triangular or "U" shaped slabs), but otherwise meet the grade criteria, then:

initial grade	**changes to**
D grade	K grade
F grade	L grade
H/I grade	M grade

8. SURFACE CLEAR

Logs which are free of knots and knot indicators are valued for use in specialty forest products, such as window and door stock. A typical log grade criteria will be written as "90% surface clear". In application this indicates 10% of the log may have knots or knot indicators on any surface [from the top of the log] with the remaining 90% of the log being clear of knots or knot indicators. Similarly, a log grade that requires 80% surface clear may have 20% of the log with knots or knot indicators on any surface [from the top of the log] with the remaining 80% of the log being clear of knots or knot indicators.

6.3 Inventory CallG rading Criteria

Fir/Pine/Larch Grades and Grade Requirements

Table 6.4 – Fir/Pine/Larch Grades and Grade Requirements.

D GRADE	**Fir/Pine/Larch**
Min. top diameter inside bark	76 cm
Min. log length	5 m
Min. percentage lumber	75%
Min. percentage clear lumber	50%
Max. twist over 30 cm of length	4% of top diameter, Max. deviation 6 cm
Grade Requirements	
Knots	• ≥ 90% surface clear, with well-spaced knots or knot indicators permitted on the upper 10% of two sides of the log or upper 20% of one side of the log only.
Rot	• No conk permitted. • Rot permitted, provided 75% lumber attained.

F GRADE	**Fir/Pine/Larch**
Min. top diameter inside bark	60 cm
Min. log length	5 m
Min. percentage lumber	75%
Min. percentage clear lumber	25%
Max. twist over 30 cm of length	4% of top diameter, Max. deviation 6 cm
Grade Requirements	
Knots	• Logs 60-74 cm must have ≥ 75% surface clear, with well-spaced knots or knot indicators permitted on the upper 25% of two sides of the log or upper 50% of one side of the log only. • Logs 76 cm or greater must have ≥ 50% surface clear, with well-spaced knots or knot indicators permitted on the upper 25% of two sides of the log or upper 75% of one side of the log only.
Rot	• No conk permitted. • Rot permitted, provided 75% lumber attained.

B GRADE (Fir only)	**Fir/Pine/Larch**
Min. top diameter inside bark	60 cm
Min. log length	5 m
Min. percentage veneer	80%
Maximum twist over 30 cm of length	7% of top diameter, Max. deviation 8 cm
Grade Requirements	
Knots	• No knots or bunch knots over 4 cm are permitted. • Logs 60-74 cm top diameter must have the lower 2.6 m free of knots or knot indicators. • Logs ≥ 76 cm top diameter must have the lower 2.6 m free of knots. Knot indicators are permitted.
Rot	• No conk rot permitted. • No butt rot permitted. • Sap rot permitted to 4% of top diameter or 5 cm in depth.
Misc.	• No splits permitted. • Sun checks or insect holes permitted to a depth of 4% of top diameter or to a maximum of 5 cm in depth. • Sweep is not permitted. • Crook is not permitted. • Burls are permitted to 1 burl per 2.6 m of log length.

C GRADE (Fir only)	**Fir/Pine/Larch**
Min. top diameter	38 cm
Min. log length	5 m
Min. percentage veneer	80%
Max. twist over 30 cm of length	7% of top diameter, Max. deviation 8 cm
Grade Requirements	
Knots	• No knots or bunch knots over 4 cm are permitted.
Rot	• No conk permitted. • No butt rot permitted. • Sap rot: – For logs < 50 cm top diameter, none is permitted. – For logs ≥ 50 cm top diameter, permitted up to 4% of the top diameter, and a maximum of 5 cm actual depth.
Misc.	• No splits permitted. • Sun checks or insect holes: – For logs < 50 cm top diameter, none is permitted. – For logs ≥ 50 cm top diameter, permitted up to 4% of the top diameter, and a maximum of 5 cm actual depth. • Sweep is not permitted. • Crook is not permitted. • Burls are permitted (1 burl per 2.6 m of log length).

H GRADE	**Fir/Pine/Larch**
Min. top diameter	38 cm
Min. log length	5 m
Min. lumber percentage: — Logs ≥ 38 cm top diameter — Logs ≥ 50 cm top diameter	 75% 50%
Min. merchantable percentage	65%
Max. twist over 30 cm of length	7% of top diameter, Max. deviation 8 cm
Grade Requirements	
Knots	• 38 — 48 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 50% of the log, with knots ≤ 2 cm in diameter permitted over the lower 50% of the log. • ≥ 50 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper $66\frac{2}{3}$% of the log* **OR** – 8 cm knots over the upper 50% of the log* (* with knots ≤ 2 cm in diameter permitted over the lower portion of the log). • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted provided percentage lumber is maintained.
Misc.	• No insect holes penetrating the sapwood permitted.

I GRADE	**Fir/Pine/Larch**
Min. top diameter	38 cm
Min. log length	4 m
Min. lumber percentage: – Logs ≥ 38 cm top diameter – Logs ≥ 50 cm top diameter – Logs 38-48 cm top diameter (former H log quality)	 75% 50% 50%
Min. merchantable percentage	50%
OR former H log quality 38-48 cm top diameter	65%
Max. twist over 30 cm of length	10% of top diameter, Max. deviation 9 cm
Grade Requirements	
Knots	• 38 — 48 cm top diameter 8 cm • 50 — 74 cm top diameter 9 cm • ≥ 76 cm top diameter 10 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 75% percentage lumber is attained.

J GRADE (same for all Coniferous species)	**Fir/Pine/Larch**
Min. top diameter	16 cm *
Max. top diameter	36 cm
Min. log length	5 m
Min. lumber percentage	75%
Min. merchantable percentage	50%
Max. twist over 30 cm of length	10% of top diameter
* Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 16 — 26 cm top diameter 4 cm • 28 — 36 cm top diameter 6 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	Permitted provided 75% lumber is attained.

U GRADE (same for all Coniferous species)	**Fir/Pine/Larch**
Min. top diameter	10 cm *
Min. log length	5 m
Min. lumber percentage: – 10–14 cm top diameter – 16–36 cm top diameter – ≥ 38 cm top diameter	 75% $66\frac{2}{3}$% 50%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
* Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres
Rot	Permitted provided percentage lumber is attained.

X GRADE (same for all Coniferous species)	**Fir/Pine/Larch**
Min. top diameter	10 cm *
Min. log length	3 m
Min. lumber percentage	33⅓%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13% Max. deviation 13 cm
* Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	**Same as "U" Grade** • 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm. • Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length
Rot	Permitted provided 33⅓% lumber is attained.

Y GRADE (same for all Coniferous species)	**Fir/Pine/Larch**
Lower than X grade.	

Cedar Grades and Grade Requirements

Table 6.5 – Cedar Grades and Grade Requirements.

D GRADE		**Cedar**
Logs	Min. top diameter	60 cm
	Min. length	5 m
	Min. percentage lumber	
	• 60–118 cm top diameter	75%
	• ≥ 120 cm top diameter	66⅔%
	Min. percentage clear lumber	50%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Slabs	Min. top diameter	50 cm
	Min. thickness	38 cm
	Min. length	5 m
	Min. percentage lumber	75%

	Min. percentage clear lumber	50%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements		
Knots	• 60 – 74 cm top diameter, ≥ 75% surface clear*, with well spaced knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only. • ≥ 76 cm top diameter, ≥ 66⅔% surface clear, with well spaced knots or knot indicators permitted on the upper 33⅓% of one side or on the upper 66⅔% of one side of the log length only.	
Rot	• Rot permitted provided percentage lumber is met.	
Misc.	• "D" quality logs with < 75% lumber OR if > 120 cm with less than 66⅔% lumber become "K" shingle	

F GRADE		**Cedar**
Logs	Min. top diameter	50 cm
	Min. length	5 m
	Min. percentage lumber	75%
	Min. percentage clear	25%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Slabs	Min. top diameter	50 cm
	Min. length	5 m
	Min. thickness	38 cm
	Min. percentage lumber	75%
	Min. percentage clear	25%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements		
Knots	• 50–58 cm top diameter, must be surface clear of knots or knot indicators. • 60–74 cm top diameter, 66⅔% surface clear with well spaced knots or knot indicators permitted on the upper 33⅓% of two sides or on the upper 66⅔% of one side of the log length only. • ≥ 76 cm top diameter, ≥ 50% surface clear with well spaced knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only.	
Rot	• Permitted provided 75% lumber is attained.	
Misc.	• "F" quality logs with < 75% lumber become "L" shingle	

H GRADE	**Cedar**
Min. top diameter	38 cm
Min. length	5 m
Min. percentage lumber	75%
Min. percentage clear	65%
Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements	
Knots	• 38–48 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 50% of the log (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log). • ≥ 50 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 66⅔% of the log* **OR** – 8 cm knots over the upper 50% of the log* (*knots ≤ 2 cm in diameter permitted over the lower portion of the log). • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Rot permitted, provided 75% lumber is attained.
Misc.	• "H" quality logs with < 75% lumber become "M" shingle provided clear requirements can be met.

I GRADE	**Cedar**
Min. top diameter	38 cm
Min. log length 4 m – top diameter ≥ 38 cm **OR**	75% L 50% M
– Logs ≥ 10 m in length – top diameter ≥ 50 cm **OR**	50% L 50% M
– Logs ≥ 10 m in length – top diameter ≥ 38 cm	50% L 65% M
– Otherwise H Grade	
Max. twist over 30 cm of length	10%, Max. deviation 9 cm
Grade Requirements	
Knots	• 38–48 cm top diameter 8 cm • 50–74 cm top diameter 9 cm • ≥ 76 cm top diameter 10 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	Permitted provided percentage lumber is attained.
Misc.	• "I" quality logs with < 75% lumber become "M" shingle provided clear requirements can be met.

J GRADE (same for all Coniferous species)	**Cedar**
Min. top diameter	16 cm*
Max. top diameter	36 cm
Min. log length	5 m
Min. lumber percentage	75%
Min. merchantable percentage	50%
Max. twist over 30 cm of length	10% of top diameter
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 16–26 cm top diameter 4 cm • 28–36 cm top diameter 6 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	Permitted provided 75% lumber is attained.

K GRADE		**Cedar**
Logs	Min. top diameter	50 cm
	Min. log length	4 m
	Min. percentage shingle or shakes	50%
	Min. percentage clear shingle or shakes	75%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Slabs	Min. top diameter	50 cm
	Min. thickness	38 cm
	Min. log length	4 m
	Min. percentage shingle or shakes	50%
	Min. percentage clear shingle or shakes	75%
	Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements		
Knots	• 50–58 cm top diameter, must be surface clear of knots or knot indicators. • 60–74 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only. • ≥ 76 cm top diameter, ≥ $66\frac{2}{3}$% surface clear with knots or knot indicators permitted on the upper $33\frac{1}{3}$% of two sides or the upper $66\frac{2}{3}$% of one side of the log length only.	
Rot	• Rot permitted provided 50% shingles or shake is attained.	
Note: D quality logs with < 75% lumber (≥ 120 cm top diameter with < $66\frac{2}{3}$ % lumber) become K shingle.		

L GRADE		**Cedar**
Logs	Min. top diameter	38 cm
	Min. log length	4 m
	Min. percentage shingle or shakes	50%
	Min. percentage clear shingle or shakes	50%
	Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Slabs	Min. top diameter	38 cm
	Min. thickness	26 cm
	Min. log length	4 m
	Min. percentage shingle or shakes	50%
	Min. percentage clear shingle or shakes	50%
	Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements		
Knots	• ≥ 50% surface clear, with knots permitted on the upper 50% of two sides or all of one side of the log length only.	
Rot	• Rot permitted provided 50% shingle or shakes is attained.	
Note: F quality logs with < 75% lumber become L shingle.		

M GRADE		**Cedar**
Logs	Min. top diameter	38 cm
	Min. log length	4 m
	Min. percentage shingles	50%
	Min. percentage clear shingles	25%
	Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Slabs	Min. top diameter	26 cm
	Min. thickness	16 cm
	Min. log length	4 m
	Min. percentage shingles	50%
	Min. percentage clear shingles	25%
	Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements		
Knots	• ≥ 25% surface clear.	
Rot	• Rot permitted provided 50% shingle or shakes is attained.	

U GRADE (same for all Coniferous species)	**Cedar**
Min. top diameter	10 cm*
Min. log length	5 m
Min. lumber percentage: – 10–14 cm top diameter – 16–36 cm top diameter – ≥ 38 cm top diameter	 75% 66⅔% 50%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	

Knots	• 10–14 cm top diameter	4 cm
	• 16–26 cm top diameter	6 cm
	• 28–36 cm top diameter	8 cm
	• 38–48 cm top diameter	10 cm
	• 50–74 cm top diameter	12 cm
	• ≥ 76 cm top diameter	14 cm
	• Occasional larger knots (OLKs) are permitted, to 1 per 3 metres	
Rot	Permitted provided percentage lumber is attained.	

X GRADE (same for all Coniferous species)	**Cedar**
Min. top diameter	10 cm*
Min. log length	3 m
Min. lumber percentage	33⅓%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	

Knots	• 10–14 cm top diameter	4 cm
	• 16–26 cm top diameter	6 cm
	• 28–36 cm top diameter	8 cm
	• 38–48 cm top diameter	10 cm
	• 50–74 cm top diameter	12 cm
	• 76 cm top diameter	14 cm
	• Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm.	
	• Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length	
Rot	Permitted provided 33⅓% lumber is attained.	

Y GRADE (same for all Coniferous species)	**Cedar**
Lower than X grade.	

Hemlock/Balsam Grades and Grade Requirements

Table 6.6 – Hemlock/Balsam Grades and Grade Requirements.

D GRADE	**Hemlock/Balsam**
Min. top diameter	66 cm
Min. log length	5 m
Min. percentage lumber	75%
Min. percentage clear	50%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• 66–74 cm top diameter, must be 90% surface clear with well spaced knots or knot indicators permitted on the upper 10% of two sides or on the upper 20% of one side of the log length only. • ≥ 76 cm top diameter, must be 80% surface clear with well spaced knots or knot indicators permitted on the upper 20% of two sides or on the upper 40% of one side of the log length only.
Rot	• No conk permitted. • Rot permitted, provided 75% lumber is attained. Rot in balsam must be confined to centre 10% of log.

F GRADE	**Hemlock/Balsam**
Min. top diameter	50 cm
Min. log length	5 m
Min. percentage lumber	75%
Min. percentage clear lumber	25%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• 50–64 cm top diameter, must be 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only. • Logs ≥ 66 cm top diameter, must be 50% surface clear with knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only.
Rot	• No conk or blind conk permitted. • Rot permitted, provided 75% lumber is attained.

H GRADE	**Hemlock/Balsam**
Min. top diameter	38 cm
Min. log length	5 m
Logs ≥ 38 cm top diameter	75% lumber 65% merchantable
Logs ≥ 50 cm top diameter Former "D" or "F" grade	50% lumber 25% clear
Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements	
Knots	• 38–48 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 50% of the log (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log). • ≥ 50 cm top diameter: – 4 cm knots over the entire log OR – 5 cm knots over the upper 66⅔% of the log* OR – 8 cm knots over the upper 50% of the log* (* knots ≤ 2 cm in diameter permitted over the lower portion of the log). • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 75% lumber is attained.

I GRADE	**Hemlock/Balsam**
Min. top diameter	38 cm
Min. log length	4 m
Logs ≥ 38 cm top diameter	75% lumber 50% merchantable
Logs ≥ 38 cm top diameter (former H grade)	≥ 50% lumber ≥ 65% merchantable
Max. twist over 30 cm of length	10%, Max. deviation 9 cm
Grade Requirements	
Knots	• 38–48 cm top diameter 8 cm • 50- 74 cm top diameter 9 cm • ≥ 76 cm top diameter 10 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided percentage lumber is attained.

J GRADE (same for all Coniferous species)	**Hemlock/Balsam**
Min. top diameter	16 cm*
Max. top diameter	36 cm
Min. log length	5 m
Min. lumber percentage	75%
Min. merchantable percentage	50%
Max. twist over 30 cm of length	10% of top diameter
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 16–26 cm top diameter 4 cm • 28–36 cm top diameter 6 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 75% lumber is attained.

U GRADE (same for all Coniferous species)	**Hemlock/Balsam**
Min. top diameter	10 cm*
Min. log length	5 m
Min. lumber percentage: – 10–14 cm top diameter – 16–36 cm top diameter – ≥ 38 cm top diameter	 75% $66\frac{2}{3}\%$ 50%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres
Rot	• Permitted, provided percentage lumber is attained.

X GRADE (same for all Coniferous species)	**Hemlock/Balsam**
Min. top diameter	10 cm*
Min. log length	3 m
Min. lumber percentage	$33\frac{1}{3}\%$
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
• Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm. • Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length
Rot	• Permitted, provided $33\frac{1}{3}\%$ lumber is attained.

Y GRADE* (same for all Coniferous species)	**Hemlock/Balsam**
Lower than X grade.	

Spruce Grades and Grade Requirements

Table 6.7 – Spruce Grades and Grade Requirements.

F GRADE	**Spruce**
Min. top diameter	76 cm
Min. log length	4 m
Min. percentage lumber	75%
Min. percentage clear lumber	50%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• Must be 90% surface clear with well spaced knots or knot indicators permitted on the upper 10% of two sides or on the upper 20% of one side of that log length only.
Rot	• No conk permitted. • Insect holes must not penetrate beyond the sapwood. • Permitted provided 75% lumber is attained.

G GRADE	**Spruce**
Min. top diameter	60 cm
Min. log length	4 m
Min. percentage lumber	75%
Min. percentage clear lumber	25%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• 60–74 cm top diameter, must be 75% surface clear with well spaced knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only. • ≥ 76 cm top diameter: – must be 50% surface clear with well spaced knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only **OR** – with whorls of large knots spaced so that 75% of the log can be cut into clear 2.6 m lengths. • ≥ 100 cm top diameter with whorls of large knots spaced so that 50% of the log can be cut into clear 2.6 m lengths.
Rot	• No conk rot permitted. • Insect holes must not penetrate beyond the sapwood. • Rot permitted if 75% lumber is attained.

H GRADE	**Spruce**
Min. top diameter	38 cm
Min. log length	4 m
Logs ≥ 38 cm top diameter	≥ 75% Lumber ≥ 65% merchantable
Logs ≥ 60 cm top diameter (former "F or G" grade)	≥ 50% lumber ≥ 25% clear
Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements	
Knots	• 38–48 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 50% of the log (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log). • ≥ 50 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 66⅔% of the log* **OR** – 8 cm knots over the upper 50% of the log* (*knots ≤ 2 cm in diameter permitted over the lower portion of the log). • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Insect holes must not penetrate beyond the sapwood. • Permitted, provided percentage lumber is attained.

I GRADE	**Spruce**
Min. top diameter	38 cm
Min. log length	4 m
Logs ≥ 38 cm top diameter	≥ 75% Lumber ≥ 50% merchantable
Logs ≥ 38 cm top diameter (former "H" grade)	≥ 50% lumber ≥ 65% merchantable
Logs ≥ 50 cm top diameter	≥ 50% lumber ≥ 50% merchantable
Max. twist over 30 cm of length	10%, Max. deviation 9 cm
Grade Requirements	
Knots	• 38–48 cm top diameter 8 cm • 50–74 cm top diameter 9 cm • 76–98 cm top diameter 10 cm • ≥ 100 cm top diameter 13 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided percentage lumber is attained.

J GRADE (same for all Coniferous species)	**Spruce**
Min. top diameter	16 cm*
Max. top diameter	36 cm
Min. log length	4 m
Min. percentage lumber	75%
Min. percentage merchantable	50%
Max. twist over 30 cm of length	10%
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 16–26 cm top diameter 4 cm • 28–36 cm top diameter 6 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 75% lumber is attained.

U GRADE (same for all Coniferous species)	**Spruce**
Min. top diameter	10 cm*
Min. log length	5 m
Min. lumber percentage: – 10–14 cm top diameter – 16–36 cm top diameter – ≥ 38 cm top diameter	 75% $66\frac{2}{3}$% 50%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres
Rot	• Permitted, provided percentage lumber is attained.

X GRADE (same for all Coniferous species)	**Spruce**
Min. top diameter	10 cm*
Min. log length	3 m
Min. lumber percentage	33$\frac{1}{3}$%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	

Knots	• 10–14 cm top diameter	4 cm
	• 16–26 cm top diameter	6 cm
	• 28–36 cm top diameter	8 cm
	• 38–48 cm top diameter	10 cm
	• 50–74 cm top diameter	12 cm
	• 76–98 cm top diameter	14 cm
	• ≥ 100 cm top diameter	16 cm
	• Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm.	
	• Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length	
Rot	• Permitted, provided 33$\frac{1}{3}$ % lumber is attained.	

Y GRADE (same for all Coniferous species)	**Spruce**
Lower than X grade.	

Cypress/Yew Grades and Grade Requirements

Table 6.8 – Cypress/Yew Grades and Grade Requirements.

D GRADE	**Cypress/Yew**
Min. top diameter	60 cm
Min. log length	4 m
Min. percentage lumber	75%
Min. percentage clear lumber	50%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• 60–74 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only. • ≥ 76 cm top diameter, ≥ $66\frac{2}{3}\%$ surface clear with knots or knot indicators permitted on the upper $33\frac{1}{3}\%$ of two sides or the upper $66\frac{2}{3}\%$ of one side of the log length only.
Rot	• Permitted, provided 75% lumber is attained.

F GRADE	**Cypress/Yew**
Min. top diameter	50 cm
Logs ≥ 50 cm top diameter	
– Min. Log Length	4 m
– Min. percentage lumber	75%
– Min. percentage clear lumber	25%
Logs ≥ 60 m top diameter (former "D" grade)	
– Min. Log Length	6 m
– Min. percentage lumber	50%
– Min. percentage clear lumber	50%
Max. twist over 30 cm of length	4%, Max. deviation 6 cm
Grade Requirements	
Knots	• 50–58 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only. • ≥ 60 cm top diameter, ≥ 50% surface clear with knots or knot indicators permitted on the upper 50% of two sides or the upper 75% of one side of the log length only.
Rot	• Permitted, provided percentage lumber is attained.

H GRADE	**Cypress/Yew**
Min. top diameter	38 cm
Min. length	4 m
Min. percentage lumber	50%
Min. percentage merchantable	65%
Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements	
Knots	• 38–48 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper 50% of the log, with knots ≤ 2 cm in diameter permitted over the lower 50% of the log. • ≥ 50 cm top diameter: – 4 cm knots over the entire log **OR** – 5 cm knots over the upper $66\frac{2}{3}$% of the log* **OR** – 8 cm knots over the upper 50% of the log* (*knots ≤ 2 cm in diameter permitted over the lower portion of the log). • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 50% lumber is attained.

I GRADE	**Cypress/Yew**
Min. top diameter	38 cm
Min. log length	4 m
Min. percentage lumber	50%
Min. percentage merchantable	50%
Max. twist over 30 cm of length	10%, Max. deviation 9 cm
Grade Requirements	
Knots	• 38–48 cm top diameter 8 cm • 50–74 cm top diameter 9 cm • ≥ 76 cm top diameter 10 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted provided 50% lumber is attained.

J GRADE (same for all Coniferous species)	**Cypress/Yew**
Min. top diameter	16 cm*
Max. top diameter	36 cm
Min. log length	4 m
Min. percentage lumber	75%
Min. percentage merchantable	50%
Max. twist over 30 cm of length	10%
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 16–26 cm top diameter 4 cm • 28–36 cm top diameter 6 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.
Rot	• Permitted, provided 75% lumber is attained.

U GRADE (same for all Coniferous species)	**Cypress/Yew**
Min. top diameter	10 cm*
Min. log length	5 m
Min. lumber percentage: – 10–14 cm top diameter – 16–36 cm top diameter – ≥ 38 cm top diameter	 75% $66\frac{2}{3}\%$ 50%
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres
Rot	• Permitted, provided percentage lumber is attained.

X GRADE (same for all Coniferous species)	**Cypress/Yew**
Min. top diameter	10 cm*
Min. log length	3 m
Min. lumber percentage	$33\frac{1}{3}\%$
Min. merchantable percentage	35%
Max. twist over 30 cm of length	13%, Max. deviation 13 cm
*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.	
Grade Requirements	
Knots	• 10–14 cm top diameter 4 cm • 16–26 cm top diameter 6 cm • 28–36 cm top diameter 8 cm • 38–48 cm top diameter 10 cm • 50–74 cm top diameter 12 cm • ≥ 76 cm top diameter 14 cm • Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length. • Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm. • Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length
Rot	• Permitted, provided percentage lumber is attained.

Y GRADE (same for all Coniferous species)	**Cypress/Yew**
Lower than X grade.	

Deciduous Grades and Grade Requirements

Table 6.9 – Deciduous Grades and Grade Requirements.

C GRADE (Cottonwood only)	**Deciduous**
Min. top diameter	25 cm
Min. log length	5 m
Min. percentage veneer	80%
Max. twist over 30 cm of length	7%, Max. deviation 8 cm
Grade Requirements	
Knots	• No knots over 4 cm in diameter are permitted. • Knots < 4 cm in diameter must be well spaced.
Rot	• No conk allowed. • No butt rot allowed.
Misc.	• No sweep permitted. • No crook permitted.

I GRADE	**Deciduous**
Min. top diameter	25 cm
Min. log length	5 m
Min. percentage lumber	50%
Min. percentage merchantable	50%
Max. twist over 30 cm of length	10%, Max. deviation 9 cm
Grade Requirements	
Knots	• 25–36 cm top diameter 4 cm • 38–48 cm top diameter 8 cm • ≥ 50 cm top diameter 9 cm
Rot	• Permitted provided 50% lumber is attained.

U GRADE		**Deciduous**
Min. top diameter		10 cm*
Min. log length		5 m
Logs 10–14 cm top diameter 16–24 cm top diameter ≥ 25 cm top diameter		75% Lumber 66% Lumber 50% Lumber
Min. merchantable percentage		35%
Max. twist over 30 cm of length		13%, Max. deviation 13 cm
* Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.		
Grade Requirements		
Knots	• 10–14 cm top diameter	4 cm
	• 16–24 cm top diameter	6 cm
	• 25–36 cm top diameter	8 cm
	• 38–48 cm top diameter	10 cm
	• ≥ 50 cm top diameter	12 cm
Rot	• Permitted, provided percentage lumber is attained.	

Y GRADE	**Deciduous**
Lower than X grade.	

6.4 Summary of Log Grades by Species

Table 6.10 – Fir/Pine/Larch log grade summary.

Grade	Min. Length (m)	Min. Top DIB (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D Lumber	5 m	76	76+	90% surface clear	75% L 50% CL	no conk, blind conk or rotten branches	4% (6 cm)
F Lumber	5 m	60	60-74	75% surface clear	75% L 25% CL	no conk, blind conk or rotten branches	4% (6 cm)
			76+	50% surface clear			
B* Peeler	5 m	60	60-74	2.6 m butt block is clear	80% V	no conk, blind conk or butt rot	7% (8 cm)
			76+	2.6 m butt block knot indicators allowed			
C* Peeler	5 m	38	38+	4 cm Maximum	80% V	no conk, blind conk or butt rot	7% (8 cm)
H** Sawlog	5 m	38	38-48	4 cm **or** — 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm **or** — 5 cm top 2/3 (rem. 2 cm max.) **or** — 8 cm top half (rem. 2 cm max.)	50% L 65% M		
I** Sawlog	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm	50% L 50% M		
			76+	10 cm			

**** Fir only ** Occasional larger knots (OLKs) 1 per 3 m***

L = Lumber CL = Clear M = Merchantable V = Veneer

Table 6.11 – Cedar log grade summary.

Grade	Min. Length (m)	Min. Top DIB (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D	5 m	60	60-74	75% surface clear	75% L 50% CL		4% (6 cm)
			76-118	66% surface clear			
			120+	66% surface clear	66% L 50% CL		
F	5 m	50	50-58	100% surface clear	75% L 25% CL		4% (6 cm)
			60-74	66% surface clear			
			76+	50% surface clear			
H ***	5 m	38	38-48	4 cm **or** — 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm **or** — 5 cm top 2/3 (rem. 2 cm max.) **or** — 8 cm top half (rem. 2 cm max.)			
I ***	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm	50% L/50% M		
			76+	10 cm	50% L/65% M		
K former D	4 m	50	50-58	100% surface clear	50% SS*	slabs >38cm thick	4% (6 cm)
			60-74	75% surface clear	75% CL		
			76+	66% surface clear			
L former F	4 m	38	38+	50% surface clear	50% SS 50% CL	slabs > 26 cm thick	7% (8 cm)
M	4 m	38	38+	25% surface clear	50% S** 25% CL	slabs >16 cm thick	7% (8 cm)

*SS = shingles or shakes **S = shingles only *** OLK = 1 per 3 m

Table 6.12 – Hemlock/Balsam log grade summary.

Grade	Min. Length (m)	Min. Top DIB (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D lumber	5 m	66	66-74	90% surface clear	75% L 50% CL	no conk, blind conk or rotten branches	4% (6 cm)
			76+	80% surface clear			
F lumber	5 m	50	50-64	75% surface clear	75% L 25% CL	no conk, blind conk, or rotten branches	4% (6 cm)
			66+	50% surface clear			
H sawlog *	5 m	38	38-48	4 cm **or** — 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm **or** — 5 cm top 2/3 (rem. 2 cm max.) **or** — 8 cm top half (rem. 2 cm max.)		or former D,F 50% M 25% CL	
I sawlog*	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm			
			76+	10 cm			

** OLK = 1 per 3 m*

Table 6.13 – Spruce log grade summary.

Grade	Min. Length (m)	Min. Top DIB Grade (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
F lumber	4 m	76	76+	90% surface clear	75% L 50% CL	no conk	4% (6 cm)
G lumber	4 m	60	60-74	75% surface clear	75% L 25%CL	no conk	4% (6 cm)
			76-98	50% surface clear or 2.6 m clear sections over 75% of the log			
			100+	50% surface clear or 2.6 m clear sections over 50% of the log			
H sawlog *	4 m	38	38-48	4 cm **or** — 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm **or** — 5 cm top 2/3 (rem. 2 cm max.) **or** — 8 cm top half (rem. 2 cm max.)			
			60+			or former F, G 50% L 25% CL	
I sawlog *	4 m	38	38-48	8 cm	75% L 50% M	**or** former H 50% L 65% M	10% (9 cm)
			50-74	9 cm	50% L 50% M		
			76-98	10 cm			
			100+	13 cm			

** OLK = 1 per 3 m*

Table 6.14 – Cypress/Yew log grade summary.

Grade	Min. Length (m)	Min. Top DIB (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D	4 m	60	60-74	75% surface clear	75% L		4%
lumber			76+	66% surface clear	50% CL		(6 cm)
F	4 m	50	50-58	75% surface clear	75% L 25% CL		4%
lumber			60+	50% surface clear		or former D (6m) 50% L 50% CL	(6 cm)
H sawlog	4 m	38	38-48	4 cm or 5 cm top half (rem. 2 cm max.)	50% L 65% M		7% (8 cm)
*			50+	4 cm or 5 cm top 2/3 (rem. 2 cm max.) or 8 cm top half (rem. 2 cm max.)			
I	4 m	38	38-48	8 cm	50% L		10%
sawlog			50-74	9 cm	50% M		(9 cm)
*			76+	10 cm			

** OLK = 1 per 3 m*

Table 6.15 – Coniferous Common Grades log grade summary.

Grade	Min. Length (m)	Min. Top DIB Grade (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
J† sawlog	5 m*	16-36**	16-26	4 cm	75% L		10%
			28-36	6 cm	50% M		
U utility ****	5 m	10	10-14	4 cm	75% L 35% M		13% (13 cm)
			16-26	6 cm	66% L 35% M		
			28-36	8 cm			
			38-48	10 cm	50% L 35% M		
			50-74	12 cm			
			76+	14 cm			
X utility ****	3 m	10	10-14	4 cm	33% L 35% M		13% (13 cm)
			16-26	6 cm			
			28-36	8 cm			
			38-48	10 cm			
			50-74	12 cm		2 oversized per 3 m	
			76+	14 cm			
Y chipper	1 m	***	Logs lower in grade than "X"				
N Missing		***	On Broken Top tree missing portion graded as N-99-00				

***Note Spruce & Cypress 4 m ** Maximum top diameter 36 cm *** No minimum diameter ****OLK 1 per 3m**

Table 6.16 – Deciduous Species log grade summary.

Grade	Min. Length (m)	Min. Top DIB Grade (cm)	Min. Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
C* peeler	5 m	25	25+	4 cm	80% V	no conk or butt rot	7% (8 cm)
I sawlog	5 m	25	25-36	4 cm	50% L 50% M		10% (9 cm)
			38-48	8 cm			
			50+	9 cm			
U utility	5 m	10+	10-14	4 cm	75% L 35% M		13% (13 cm)
			16-24	6 cm	66% L 35% M		
			25-36	8 cm	50% L 35% M		
			38-48	10 cm			
			50+	12 cm			
Y chipper	1 m		Logs lower in grade than "U"				
N Missing		***	On Broken Top tree missing portion graded as N-99-00				

*** Cottonwood only** ***** No minimum diameter**

7. Plants, Soils,a nd Old Growth

Introduction

The data collected in this section of the inventory will be used in a variety of ways:

- To provide data for management and research applications, such as enhancement of the provincial ecological classification system, particularly in previously undescribed ecosystems and managed successionally younger ecosystems.
- To generate vegetation lists, including species codes and percentage cover values, and to assist in wildlife management and resource planning.
- To build a database that will permit different users to track floristic changes over time, in different regions, and in a variety of biogeoclimatic zones or subzones.
- To assist in the calculation of total ecosystem carbon.

Objectives

- To establish a network of sample plots that can be located and re-sampled in the future.
- To collect accurate information about plant species composition in National Forest Inventory sample plots.
- To identify, estimate, and measure selected soil and site features to provide a record of conditions at National Forest Inventory sample plot locations.
- To determine the successional characteristics of the stand.
- To classify National Forest Inventory sample plots using the biogeoclimatic ecosystem classification system, the British Columbia Land Cover Classification Scheme, and to identify the site series.
- To describe forested as well as non-forested ecosystems.

General Procedures

The following is a recommended sequence of steps in collecting the ecological measurements (steps 3 and 4 may be interchanged):

1. Establish the 10 m fixed-radius plot and the 5.64 m sub-plot.
2. Describe vegetation in the 5.64 m and 10 m fixed-radius plots before the soil pit is dug and the site is trampled too much.
3. Record the site and soil description.
4. Sample the coarse woody debris transects (Cards EW and EC) discussed in Section 8. CWD sampling can provide insights into successional processes and recent stand history on sampled sites.
5. Interpret the successional characteristics of the stand. Refer to other data collected to make successional interpretations.

Field Cards for this Section

Ecological Description 1 (EP) (Appendix A, Figures A.14 & A. 15)
Site classification, site features, soil features, soil description for pin location and summary information

Ecological Description 2 (ED) (Appendix A, Figures A.16 & A.17)
As above, for when plot centre not in dominant site

Tree and Shrub Layers (ET) (Appendix A, Figures A.18 and A.19)
Species, and cover by species and for seedlings

Herb and Moss Layers (EH) (Appendix A, Figures A.20 and A.21)
Species, and cover by species and substratum

Succession Interpretations (EO) (Appendix A, Figures A.22 and A.23)
Factors influencing vegetation establishment, tree species succession, stand structure features, structural stages, old growth assessment

Detailed Procedures

7.1 Establishing Plots

The main ecological plot is 10 m radius (314 m^2), centered on the Integrated Plot Centre. It is used to collect vegetation data from the tree and shrub layers, and for site description, soil, and site classification.

The nested subplot is 5.64 m radius (100 m^2), also centered on the Integrated Plot Centre. It is used to sample vegetation in the herb and moss layers, and tree seedlings.

In order to evaluate slope gradient, aspect, meso slope position, succession interpretations, and a number of other attributes it is necessary to look beyond the 10 m main ecological plot to an approximate radius of 25 m around the Integrated Plot Centre, depending on the attribute, site variability, and topographic breaks.

The inventory sampling method does not allow movement of the ecological plot to more "typical" or homogeneous portions of the area as this would introduce sampling bias. Some plots may therefore contain more than one site series. This may lead to difficulties with secondary applications of the data such as ecological classification.

To address this concern, field crews will assess the ecological variability (uniformity) of the plot and estimate the relative proportions of component site series and/or land cover classes comprising a plot. If the Integrated Plot Centre does not fall in the dominant site series (within the 10 m plot), then additional soil and site data are needed for the dominant site series.

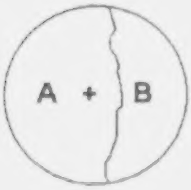
Procedure

Measure the 10 m and 5.64 m plots and flag at appropriate intervals around the circumferences of the plots to demarcate plot boundaries. For detailed procedures, see Section 3: Plot Establishment.

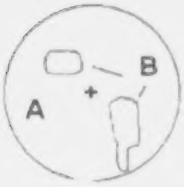
7.2 Assessing Ecological Variability

1. Assess the ecological variability within the integrated plot. If more than one site series occurs, identify the dominant site series (occupying the greatest proportion of the plot) and determine whether the plot centre falls within this site series. The dominant site can occur as discontinuous patches or as one contiguous area in the plot.
2. If the plot centre falls within the dominant site series, record only one site series and soil description (Field Card EP).
3. If the plot centre is not in the dominant site series, record the site features of the plot centre on Field Card EP, and a second set of soil and site features for the dominant site on Field Card ED.
4. Record the percentage cover of site series and land cover class, or land cover alone if site series does not apply.

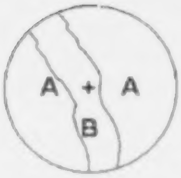
5. Figure 7.1 illustrates some situations that may be encountered. Note that only one plant list is done for the entire plot, in all cases.



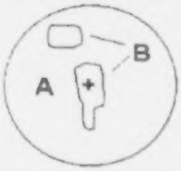
♥ Example 1: plot centre is in dominant site series (A)
- complete one site and soil description at plot centre
- complete EP card for A only.



♥ Example 2: plot centre is in dominant site series (A); subdominant (B) is discontinuous
- complete one site and soil description at plot centre
- complete the EP card for A only.



♥ Example 3: plot centre is subdominant site series (B)
- complete one site and soil description at plot centre
- complete **another** site/soil description within dominant site (A)
- complete ED card for A and EP card for B.



♥ Example 4: plot centre is in subdominant (B), but site series is discontinuous
- complete one site and soil description at plot centre
- complete **another** site/soil description at dominant site (A)
- complete ED card for A and EP card for B.

Figure 7.1 — Assessing uniformity and attributes in areas with ecological variability within the 10 m fixed-radius plot.

7.3 Identifying and Recording Site and Soil Features

The following classifications are based on all the observations taken in this section. Record your observations on the field cards in the numbered areas indicated for each observation.

A. Site Classification

1. UNIFORMITY

Record the uniformity of the plot using the five-class scale shown in Table 7.1.

Table 7.1 – Plot uniformity codes.

Code	Description
1 — (uniform)	> 98% of plot in one homogeneous* ecosystem or site series
2	> 90%–98% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**
3	> 70%–90% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**
4	> 50%–70% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**
5 — (variable)	50% or less of plot is the largest homogeneous* ecosystem or site series

* *Homogeneous* means the same site series and structural stage.

** *Other ecosystems* include different successional and structural stages (for example, major structural differences beyond that of understorey vegetation associated with smaller canopy gaps due to mortality of 1-3 trees) as well as different sites (different site series, or inclusions of avalanche tracks, streams, gullies, rock outcrops, roads).

2. BIOGEOCLIMATIC UNIT

Record the biogeoclimatic unit as determined on the ground. This includes zone, subzone, variant, and phases (if applicable).

Note: Biogeoclimatic phases have not been defined for all variants. An example of a phase is the ICH mc1a (ICH Zone, Moist Cold Subzone, Nass Variant, Amabilis Fir Phase) as described in Chapter 5 page 116 of the *Field Guide to Site Identification for the Prince Rupert Forest Region*.

For a concise introduction to biogeoclimatic and site unit terminology see *Ecosystems of British Columbia* (Meidinger and Pojar 1991).

A digital copy of valid codes for "Biogeoclimatic Unit" and "Site Series and Coverage" is available (boxes 2 and 3 on the EP12 card). This complete list of BEC Zones, Subzones, Variants, Phases and matching Site Series is available from the MoF Research Branch website. It is called **BECdb.mdb**. Currently it is only available as a relational database file (MS Access 97). To obtain a copy, go to the following website:

http://www.for.gov.bc.ca/hre/becweb/standards-becdb.htm

These are the official provincial codes from Research Branch. MoF Research Branch is the data custodian of the BEC and Site Series information.

3. SITE SERIES AND COVERAGE

As clarified by Klinka et al. (1989), *Indicator Plants of Coastal British Columbia,* site series identification is aided by indicator plants, even when their cover and vigour are low and their presence is sporadic. Although, the NFI ecological methodology does suggest you do not need to record genera or species with less than 1% coverage, this does not imply that such plants should be ignored when doing site series identification.

1. Identify the site series at the plot centre and up to 2 other sites within the 10 m radius plot.
2. Enter the three-character site series/phase code from the appropriate MOF regional field guide to site identification and interpretation.
3. If the plot occurs on an ecosystem not recognized in the ecological classification, record the soil moisture regime (SMR) and soil nutrient regime (SNR). If these values cannot be estimated (for example, roads, gravel pits, boulder fields), record "site series #" as 99_ and in the SMR and SNR columns record a dash (–).
4. Estimate the coverage of each site series as a percentage of the 10 m plot, to a maximum of 100% if there is only one site series.

Note: Second and third site series or land cover classes covering less than 5% (16 m^2) are considered too small to recognize.

4. SOIL MOISTURE REGIME

Relative Soil Moisture Regime (**SMR**) refers to the average annual amount of soil water available to plants, relative to a given biogeoclimatic subzone variant. This attribute is particularly valuable when the site series is not defined.

1. Record SMR for the plot centre and up to two other sites.
2. The SMR classes, given in Table 7.2, are inferred from the physiographic and soil features described. (A more complete description and keys are in the relevant regional field guide and in *Describing Ecosystems In The Field,* Luttmerding et al. 1990.)

Table 7.2 – Relative Soil Moisture Regime codes.

Code	Description
0	very xeric **(very dry)**
1	xeric
2	subxeric

3	submesic
4	mesic
5	subhygric
6	hygric
7	subhydric **(very wet)**
8	hydric (certain wetland ecosystems and persistent standing water)

5. SOIL NUTRIENT REGIME

Soil Nutrient Regime (**SNR**) refers to the amount of essential soil nutrients, particularly nitrogen, available to plants. This attribute is particularly useful when the site series cannot be determined in other ways.

1. Record SNR for the plot centre and up to two other sites.
2. The SNR classes, given in Table 7.3, are inferred from the physiographic and soil features described. (A more complete description and keys are in the relevant regional field guide and in *Describing Ecosystems In The Field,* Luttmerding et al. 1990.)

Table 7.3 – Soil Nutrient Regime codes.

Code	**Description**
A	very poor
B	poor
C	medium
D	rich
E	very rich
F	ultra rich or saline (rarely used, but may be encountered)

6. LAND COVER CLASSIFICATION

Please refer to Appendix G for a description of the land cover levels and simplified flow charts.

1. Record the land cover class to the appropriate level.
2. Record up to three separate land cover designations if necessary, corresponding on a one-to-one basis with up to three site series designations (in a highly variable 10 m radius plot).
3. If "99_" is recorded for site series, then the land cover classification still provides a description for that area of the plot.
4. Map the land cover classes encountered on to the CL field card in the section for "Integrated Plot Details (top view)".

Note: Second and third site series or land cover classes covering less than 5% (16 m^2) are considered too small to recognize.

See Table 7.4 for a condensed version of the B.C. Land Cover codes. A more detailed description can be found in Appendix G. For full definitions and tables, please refer to the current Vegetation Resources Inventory B.C. Land Cover Classification Scheme Manual.

Table 7.4 – B.C. Land Cover Classification codes in condensed form.

	Level I	
	Codes	Description
	V	**Vegetated** Total cover of tree-, shrub-, herb-, and moss-layers (other than crustose lichens) = 5% of the site within the 10m radius plot.
	N	**Non-vegetated** Total cover of tree-, shrub-, herb-, and moss-layers (other than crustose lichens) < 5% of the site within the 10m radius plot.
	Level II	
	Codes	Description
V	T	**Treed** = 10% of the area is covered in tree species of any size.
	N	**Non-Treed** < 10% of the area is covered in tree species of any size.
N V	L	**Land** More than half of the area is not covered by water as defined below.
	W	**Water** More than half of the area is covered by a naturally occurring static water body = 2m in depth in some portion, or flowing water between continuous definable banks. These flows may be intermittent or perennial; but does not include ephemeral flows where a channel with no definable banks is present. Islands within streams that have definable banks are not part of the stream; gravel bars are part of the stream.
	Level III	
	Codes	Description
N V o r V	W	**Wetland** Includes SMR = 7 and wetter. Land having the water table near, at, or above the soil surface, or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by poorly drained soils, specialized vegetation, and various kinds of biological activity which are adapted to the wet environment.
	U	**Upland** Includes everything between wetland and alpine; SMR ranges from 0 to 6.
	A	**Alpine** Treeless by definition (for practical purposes =1 % tree cover can be included) with vegetation dominated by shrubs, herbs, graminoids, bryoids and lichens. Much of the alpine is covered by primarily rock, ice and snow.
	Level IV	
	Codes	Description
V	TB	**Treed Broadleaf** Total cover of broadleaf trees is = 75 % of the total tree cover, and tree cover is = 10%.
	TC	**Treed Coniferous** Total cover of coniferous trees is = 75 % of the total tree cover, and tree cover is = 10%.
	TM	**Treed Mixed** Neither coniferous nor broadleaf trees cover = 75 % of the total tree cover, and tree cover is = 10%.
	ST	**Shrub Tall** Shrub site with height > 2 m and = 10 m.
	SL	**Shrub Low** Shrub site with height = 2 m.
	HE	**Herb** Herb site with no distinction between forbs and graminoids.
	HF	**Herb – Forbs** Herb site with forbs (non-graminoid) > 50% of the herb cover.
	HG	**Herb – Graminoids** Herb site with graminoids (grasses, sedges & rushes) > 50% of herb cover.
	BY	**Bryoid** Bryoid site with no distinction between mosses, liverworts, hornworts and lichens.
	BM	**Bryoid – Moss** (bryophytes) Bryoid site with mosses, liverworts and hornworts forming > 50% of the bryoid cover.
	BL	**Bryoid – Lichens** Bryoid site with lichens (not crustose) forming > 50% of the bryoid cover.
N V	SI	**Snow / Ice** Permanent snow or ice.
	RO	**Rock / Rubble** Bedrock or fragmented rock moved to present position by gravity or ice.
	EL	**Exposed Land** All other forms of exposed land.

	Level V				
	Codes	Description			
V	DE	**Dense** Tree, shrub or herb cover 61–100%	NV	LL	**Landing**
	OP	**Open** Tree, shrub or herb cover 26–60%, or bryoids =50%		BU	**Burned Area**
	SP	**Sparse** Treed cover 10–25%, and shrub and herb cover <26%		RZ	**Road Surface**
	CL	**Closed** Bryoid site, with bryoid cover > 50%		MU	**Mudflat Sediment**
N V	GL	**Glacier**		CB	**Cutbank**
	PN	**Snow Cover**		MN	**Moraine**
	BR	**Bedrock**		GP	**Gravel Pit**
	TA	**Talus**		TZ	**Tailings**
	BI	**Blockfield**		RN	**Railway**
	MZ	**Rubbly Mine Spoils**		UR	**Urban**
	LB	**Lava Bed**		OT	**Other**
	RS	**River Sediments**		LA	**Lake**
	ES	**Exposed Soil**		RE	**Reservoir**
	LS	**Pond or Lake Sediments**		RI	**River / Stream**
	RM	**Reservoir Margin**		OC	**Ocean**
	BE	**Beach**			

Comments

Record on the field cards any items of ecological interest that have been otherwise missed. Preface your remarks with card and attribute identification.

B. Site Features

Site features such as slope, aspect, surface shape, meso slope, microtopography, rocky substrates, flood hazard, and open water should be assessed only for the particular site being described. For example, in the event of a site A and a site B (see Figure 7.1; examples 3 and 4 requiring EP and ED cards), do not average any of the above attributes (7, 8, 10, 11, 12, 13, 16, and 17) across the two site series. Record separate values on the EP and ED field cards.

7. SLOPE (%)

Record the slope gradient to the nearest percent. On uniform conditions, assess slope by averaging over a 100 m distance (50 m above and below the plot centre). On the EP card give more weight to the slope conditions at the IPC, particularly when the IPC falls within a topographically different site series, compared with the remainder of the 10 metre radius plot. If there is a major topographic break in the slope, measure only to the break point. If required, record separate values on the EP and ED cards.

8. ASPECT (°)

Record the orientation of the downward slope (in degrees) using a compass bearing. On the EP card give more weight to the slope orientation at the IPC, particularly when the IPC falls within a topographically different site series, compared with the remainder of the 10 metre radius plot. Level ground (less than 2% slope) has no aspect; code as 999. If the aspect is "due north" the value is recorded as "000" degrees. If required, record separate values on the EP and ED cards.

9. ELEVATION (M)

Record the elevation of the plot centre in metres.

10. SURFACE SHAPE

Describe the general shape of the slope the site is situated on (convex, straight, concave). If required, record separate values on the EP and ED cards.

11. MESO SLOPE

Meso slope describes the relative position of the site within a local catchment area, which affects surface and subsurface water flow to the plot. Slope position relates to the segment of slope between prominent topographic irregularities (for example, major slope breaks). If required, record separate values on the EP and ED cards.

1. Describe the meso slope of the site. Refer to Figure 7.2 for descriptive terms.
2. Record using the codes described in Table 7.5.

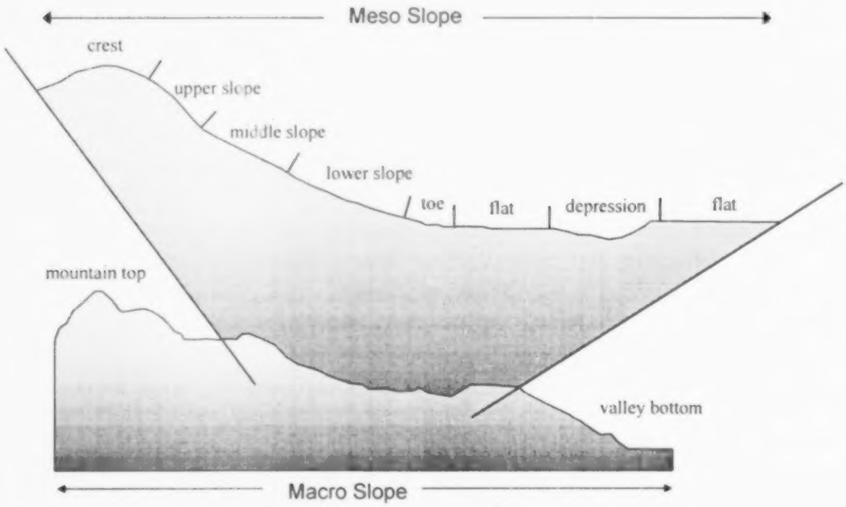


Figure 7.2 — Side view showing meso slope descriptive terms

Table 7.5 – Meso slope codes.

Code	Description
C	**crest** the generally convex upper portion of a hill.
U	**upper slope** the generally convex upper portion of the slope immediately below the crest.
M	**middle slope** the area of the slope between the upper slope and the lower slope where the slope is generally neither distinctly convex or concave.
L	**lower slope** the area towards the base of a slope, generally concave.
T	**toe** the area demarcated from the lower slope by an abrupt decrease in slope gradient.
D	**depression** any area that is concave in all directions.
F	**flat** any level area not directly adjacent to a slope (for example, toe). The surface profile is generally horizontal.

12. MICROTOPOGRAPHY

1. Microtopography describes the variability (or mounding) of the surface of the site being described. If required, record separate values on the EP and ED cards.
2. Record one of the classes of microtopography shown in Table 7.6.

Table 7.6 – Microtopography codes.

Code	Description
SM	**smooth** few or no mounds; if present, less than 0.3 m high and more than 7 m apart
MO	**moderately mounded** mounds 0.3 to 1 m high and 3 to 7 m apart
ST	**strongly mounded** mounds 0.3 to 1 m high and less than 3 m apart
EX	**extremely mounded** mounds more than 1 m high

13. ROCKY SUBSTRATES

1. Estimate the percentage of the within-site ground surface covered by rocky substrates within the 10 m radius plot. If required, record separate values on the EP and ED cards.
2. Record percentage for codes listed in Table 7.7.

Table 7.7 – Rocky substrate codes.

Codes	Description
CS	**cobbles/stones** exposed rock fragments larger than 7.5 cm* diameter; may be covered by mosses or lichens, for example, with a forest floor less than 1 cm thick.
BR	**bedrock** exposed bedrock that may be covered by mosses or lichens, for example, with a forest floor less than 1 cm thick.
*Coarse fragment size or diameter is measured along the b axis, where a = length, b = width, and c = height (a > b > c).	

14. SLOPE FAILURE

1. Note any evidence of recent or past slope failure greater than 100 m^2 surface area in the plot or intercepted by a portion of the 11.28 m plot. Evidence of failure includes landslides, slumps, debris flows, debris torrents, and bedrock failures. For further information about slope failure refer to Chatwin (Chatwin et al. 1994).
2. Record if present in the plot (Y or N).
3. Features that would indicate slope instability are shown in Table 7.8.

Table 7.8 – Indicators of slope instability.

- obvious recent failures (tracks of exposed soil oriented downslope)
- headwall or sidewall scarps that are rectangular or horseshoe shaped
- deposits of slide materials at the base of the failure which are fan-shaped and often hummocky
- a significant difference in vegetation (species and age) from the surrounding area, which may indicate older failure tracks
- generally on steeper slopes, and often in association with wet sites (seepage zones, draws, and so on)

15. GULLIES

Gullies are long, linear depressions incised into the landscape by active erosion processes, mainly running water in places accompanied by mass movement and/or snow avalanching. Where the stream channel is confined in a narrow ravine with banks usually higher than 3 m. The longitudinal profile may range from gentle to steep, and uniform to irregular (benched). The cross-section profile may be V-shaped to U-shaped with moderate to steep sidewalls (50% or greater slope). Dry draws (gully shaped features without a stream) with long established vegetation and soils, and stream channels with none of the above active or potentially active sidewall erosion features are not included.

1. Note the presence of gullies in the main plot or intercepted by a portion of the 11.28 m plot.
2. Record if present in the plot (Y or N).

16. FLOOD HAZARD

Estimate the relative frequency of flooding of rivers, creeks, and streams using the biophysical features shown in Table 7.9. If required, record separate values on the EP and ED cards.

Table 7.9 – Indicators of flood hazard.

Flood hazard	Flood frequency	Overbank deposits	Vegetation	Topography	Litter cover
Frequent F	subject to annual flooding	recent organic or inorganic deposits may be present	none, or species of primary colonization	low lying areas adjacent to the potential flood waters	none or very thin layer of fresh litter
Occasional O	occasionally flooded	recent organic or inorganic deposits may be present	mature vegetation, typically deciduous species; conifers restricted to elevated sites	areas of moderate elevation relative to the potential flood waters	thin forest floor ranging from fresh to partially decomposed material
Rare R	subject to flooding at high stage	no evidence of recent organic or inorganic overbank deposits	mature vegetation, includes coniferous species	areas of high elevation relative to the potential flood waters	thicker forest floor with developed profile
Not Applicable N	not subject to flooding			well above or away from potential flood waters	

(adapted from *Describing Ecosystems in the Field* Luttmerding et al. 1990).

17. OPEN WATER

1. Estimate the within-site area covered by either flowing (**F**) or standing water (**S**). If required, record separate values on the EP and ED cards.
2. Record as a percentage.

C. Soil Features

1. Dig a soil pit to represent the centre point of the Integrated Plot and representative of conditions at the plot centre, regardless of which point is the most representative of the dominant site of the 10 m radius plot.
2. Dig a second soil pit if necessary to represent the most dominant site. Complete a second soil pit only where the dominant site (versus the IPC site) is clearly one of contrasting site quality due to obviously different site and soil conditions.
3. The soil pit should be a minimum of 60 cm deep unless impenetrable material is encountered. If a soil pit cannot be excavated on the plot, draw a line through the soil features section on the field card and note the reason in the comments.
4. Upon completion of the sample, refill the soil pit.

18. SURFICIAL MATERIAL

Surficial material refers to the soil parent materials. They are classified according to their mode of formation. The following description is based on the *Terrain Classification System for British Columbia* (Version 2), Howes and Kenk 1997.

1. Record the surficial materials seen in the soil pit using the appropriate code shown in Table 7.10.
2. If two types of material are observed, record both (for example, C_/M_ [colluvial over morainal]).

Table 7.10 – Surficial material codes.

Code	Description
A __	**Anthropogenic** • landfill, mine spoils, roadfill
C __	**Colluvium** • deposits a direct result of gravity (talus, landslide deposits) • on steep terrain; below rock bluffs • coarse fragments, angular, same rock type as bedrock • coarse fragment >35%, loosely packed, porous. • landslide and slope failure deposits
E __	**Eolian** • wind action (loess, dunes) • well-sorted silt or fine sand, loose and fluffy • a capping over other material
F __	**Fluvial** • transported & deposited by streams or rivers (floodplain, fluvial terrace, fan, delta) • deposits gravels, sands, and/or silts, depending on stream velocity • rounded gravels • well sorted, stratified • topography flat, or steep erosional scarp • along valley bottoms near a river or stream
FG	**Glaciofluvial** • deposited by glacial meltwater streams in front of, within, or along margins of glacial ice (eskers, kame terraces, outwash) • coarse-textured, non-sorted to well-sorted, gravels and sands, with layers of finer textured materials • topography flat, sometimes steep erosional scarp • along valley bottoms, up valley sides, or extensive plain outside valley systems • gravel pits are often present
L __	**Lacustrine** • old lake bottoms or old lake beaches • stratified silts and clays, often with varves • glaciolacustrine sediments may contain ice-rafted stones and lenses of morainal or glaciofluvial material • topography flat, sometimes with a steep erosional scarp, along valley bottoms • slumps and landslides are often present

Code	Description
M __	**Morainal "Till"** • (till) deposited directly by glacial ice • highly variable, compacted to non-compacted sediments, unsorted mixture of coarse and fines • looks like "cement" • stones of different rock types may have striations (grinding marks from the ice). The most widespread and variable parent material in B.C.
O __	**Organic** • wetland (peat, muck in bogs, fens, swamps) and forest floor overlying bedrock (LFH >10 cm thick; noted as O/R)
R __	**Bedrock** • exposed bedrock , organic layer (<10 cm)
V __	**Volcanic** • unconsolidated ash, cinders • cappings over other parent materials (for example, V / M)
W __	**Marine** • salt water deposits old mud flats old beaches • fine textured (silts and clays) often dense • old beaches are well-sorted sands and/or gravels with rounded coarse fragments • shells, marine concretions • flat or very gently sloping • lower elevations near the ocean (as high as 200 m above present sea level in the Georgia Strait area) • glaciomarine sediments similar to marine except may contain stones and lenses of morainal or glaciofluvial materials

19. DEPTH TO: (IN CM)

Record the observed depth from the "0 depth" (mineral soil surface for mineral soils, ground surface for organic soils) to each of the features shown in Table 7.11, if present within the soil profile.

Table 7.11 – Soil features codes.

Code	Description
W	**water table or seepage** Measure to the free water surface in the soil, or to the line along which water emerges. Free water may collect as the result of a high groundwater table or it may be due to a temporary accumulation of water above a relatively impermeable layer. Depth to water table and depth to seepage are closely related concepts which are combined here to avoid unnecessary difficulties in the field.
M	**mottles (not applicable in organic soils)** Measure to the surface of orange to red (oxidized) spots or blotches within a predominantly dull yellow, grey, blue, or olive-coloured (reduced) mineral soil horizon. Mottles are characteristic of soils with periodic intense reduction (absence of free oxygen from the atmosphere). The mottled zone often overlies a permanently reduced, or strongly gleyed horizon of dull bluish to grey colour (often indicated by **presence of a water table or seepage**). Mineral soils with more intensely reduced conditions have relatively greater volumes of bluish-grey colours. Soils become reduced when they are anaerobic, or deficient in oxygen – which happens when microorganisms and plant

Code	Description
	roots use oxygen faster than it can be replaced from the atmosphere, or when oxygen entry is blocked, as in compact basal till. The colours associated with mottles and gleying are due to the effects of oxidation and reduction on iron, aluminum, manganese, and other metals.
R	**root-restricting pan** Measure to layers that impede root penetration (pans, cemented horizons, compact parent materials).
B	**bedrock** Measure to consolidated bedrock. Weathered bedrock that can be removed with a shovel should be considered soil.
F	**frozen layer** Measure to the top of a frozen layer.
C	**carbonates** Measure to the top of a layer containing carbonate accumulations.
N	**not observable (glacier, paved surface, lake)**

20. HUMUS FORM

Humus refers to the forest floor and organic-enriched surface mineral horizons.

Describe the humus form as one of the types shown in Table 7.12.

Table 7.12 – Humus form codes.

Code	Description
MO	**Mor** LFH horizons prominent, F horizon is matted, with abundant fungal mycelia, mushroom smell common, usually abrupt transition to mineral soil.
MM	**Mormoder** intergrade between Mor and Moder, F horizon not strongly matted and often variable with clumps of matted material and pockets of friable material, fungal mycelia and insect droppings may both occur, but neither clearly predominates over the other.
MD	**Moder** LFH horizons prominent, F horizon loose and friable, fungal mycelia less common, insects and droppings common, rich "potting-soil" smell, may have thin Ah horizons
MR	**Mullmoder** intergrade between Moder and Mull, features well developed F and H (F+H horizons >2 cm thick) but Ah present which is thicker than the F+H horizons.
MU	**Mull** Ah horizon prominent, F + H horizons <2 cm thick, F horizon very friable, Ah granular, earthworms often present.
NA	**Not applicable** use this option when none of the above humus forms apply. For example, in situations where there is very little or no surface organic matter, such as on bare bedrock, on fresh mineral deposits (floodplain sands, active talus slopes), and on road surfaces. The L, F, H horizons are freely drained, upland organic horizons which are found on most mineral soils, and occasionally on some organic soils. You may need to use this category when describing wetland ecosystems.

21. SOIL COLOUR

1. Describe the general colour of the rooting-zone mineral soil.
2. Record one of the categories shown in Table 7.13.

Table 7.13 – Soil colour codes.

Code	Description
D	**dark** chocolate brown or black (Munsell colour value <4 when moist)
M	**medium** intermediate colour (most commonly encountered)
L	**light** very pale soil (Munsell colour value >6 when moist)
N	**not applicable** (bedrock, no soil)

D. Soil Description

22. HORIZON

1. Record the main types of organic and mineral horizons.
2. Enter the appropriate code left justified, using Table 7.14, beginning with the uppermost horizon, followed by subsequent horizons proceeding down through the profile.
3. Horizons include L _ _, F _ _ & H _ _, Ah _, Ae _, B _ _, and C _ _.
4. Differentiate subdivisions of the B or C horizons (for example, B1 _, B2 _) if they differ substantially in colour, texture, coarse fragments, or structure.
5. Subordinate horizons of B and C (for example, Bf _, Bf1, Bf2, Bfg, Bt _, and Bm _) may be recorded if they can be confidently identified. The soil classification system follows the *Canadian System of Soil Classification* (1998) with additional combinations specific to British Columbia. The additional combinations are documented in the "Field Manual for Describing Terrestrial Ecosystems". A list of allowable codes can be found on the Resource Information Branch website for reference.

Table 7.14 – Examples of important soil horizons.

Horizon	Description
L _ _	an upland organic horizon consisting of relatively fresh, undecomposed plant residues.
F _ _	an upland organic horizon consisting of partly decomposed plant residues in which fragmented plant residues are generally recognizable as to origin.
H _ _	an upland organic horizon comprised of well-decomposed plant residues in which plant structures are generally not recognizable.
	Note: F _ _ and H _ _ can be combined and recorded as an FH _ horizon if they are difficult to distinguish
Ah _	surface mineral horizons enriched with organic matter (darker coloured than underlying horizon)

Horizon	Description
Ae __	surface mineral horizons leached (eluviated) of organic matter, Fe, Al, and other elements (lighter [usually light greyish] coloured than underlying horizon).
B __ __	mineral horizons affected by pedogenic processes and characterized by enrichment in organic matter, Fe and Al, clay, or by the development of soil structure, or by a change in colour indicating gleying or oxidation.
C __ __	mineral horizons relatively unaffected by pedogenic processes except gleying, and accumulation of carbonates and salts. It represents the unweathered parent material.
Of __	a wetland organic horizon consisting of poorly decomposed plant residues that are readily identifiable as to origin ("peat").

Horizon	Description
Om __	a wetland organic horizon consisting of partly decomposed plant residues which are at a stage of decomposition intermediate between Of and Oh horizons ("peat").
Oh __	a wetland organic horizon consisting of well decomposed plant residues ("black muck").
R __ __	bedrock

23. DEPTH (CM)

1. Record the average distance from 'zero' depth for each horizon in the profile (Figure 7.3).
    - For forest floor horizons (L, F, H) zero depth is the boundary between organic and mineral horizons. Depths are measured from the ground surface to 0 depth (for example, in the diagram, L: 6, F: 4, H: 2).
    - For mineral horizons, zero depth is the top of the uppermost mineral horizon, and lower boundary depths are measured in descending order (for example, in the diagram A: 3, B: 10, C: 60).
    - For organic soils, zero depth is the top of the organic material. Organic soils are soils with greater than 60 cm of organic material (if surface horizons are Of _), or greater than 40 cm of organic material (if surface horizons are Om _ and Oh _), or greater than 10 cm thick if they overlie rock, as described on pp. 97-99 in the *Canadian System of Soil Classification* (1998).
2. Record the total depth of the soil pit (DOP).

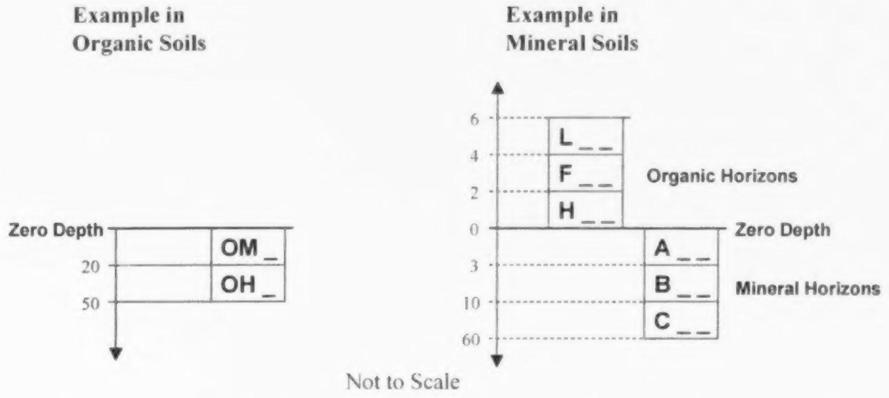


Figure 7.3- Example of recording horizon depth in organic soils and mineral soils.

24. TEXTURE

1. Estimate the texture of the mineral soil (grains 2 mm or less in diameter) using field estimation methods as described in *MOF Regional Ecology Field Guides to Site Identification and Interpretation.*

2. Estimate texture of each mineral soil horizon, not just the main horizon.

3. Enter the appropriate codes.

25. COARSE FRAGMENTS

1. For each mineral soil horizon, estimate the proportion of the total volume of soil material occupied by mineral particles larger than 2 mm in diameter.
2. Record the total coarse fragment percentage. Coarse fragment size or diameter is measured along the b axis, where a = length, b = width, and c = height (a > b > c).
3. Break this total down into two categories:
   - gravel (greater than 2 mm and less than 7.5 cm)
   - cobbles and stones (greater than or equal to 7.5 cm)

E. Surface Substrate and Soil bulk Density Measurements

Introduction

In support of National Forest Inventory (NFI) requirements for the measurement of total ecosystem carbon stocks (TECS), a need was identified for the collection of data related to:

- Surface substrates (decaying wood, bedrock, cobbles and stones, mineral soil, organic matter and water)
- Forest floor organics
- Soil bulk density and carbon content

The data from these measurements will be applied in reports on climate change, criteria and indicators of sustainable forest management, biodiversity and forest health.

Surface Substrate Sampling

Objectives

To determine percent surface substrate for NFI sample plots. This will be determined by measuring 10 sample points taken at every metre along each of the woody debris transects (total of 20 sample points) to the edge of the large tree plot boundary.

Definitions

Percent surface substrate, for the purposes of this inventory, is defined as the proportion of the ground surface covered by each class of substrate with the corresponding depth. Surface substrate descriptions are listed in Table 7.15.

The total for all six classes must sum to 100%.

General Procedures

1. Set out two, randomly oriented, 30-metre woody debris transects (the same transects as used for woody debris).
2. Measure and record information for surface substrate type and depth (where applicable) to the edge of the large tree plot boundary.

Detailed Procedures

Surface substrate is measured every metre for 10 meters, along the two, 30-metre line transects extending from the Integrated Plot Center. Detailed field forms are shown in Appendix M.

1. Establish the woody debris line transects as per woody debris protocol.
2. For every metre along the woody debris transect, check the box applicable to the surface substrate type.
3. For organic substrate and buried wood, measure and record the depth in centimetres.
4. Total the number of surface substrate occurrences in each category.
5. Note: in plots where the organic layer throughout the transect is greater than 40 cm thick, depth measurements need only be recorded every second metre of transect. If only a portion of the line falls in deep organics (for example, a swamp) where the actual measurements would be difficult, an estimate should be made of the interim locations. The maximum depth that would be measured in thick organic layers would be to 40 cm. (record the depth as >40).
6. Anomalous conditions: if the sample point along the transect lands in an anomalous site, such as a cone pile, squirrel cache, debris pile, or large ant hill, the surface substrate would be classified as organic and a depth to mineral soil would still be measured. A note should be made in the comments section for this location. If the sample point lands on a sound log, the sample point should be moved to just beside the log.

Table 7.15 - Surface substrate classes and definitions.

Surface Substrate	Definition
Organic matter	Surficial accumulations of organic materials include the following: ▪ organic layers ≥ 1 cm thick overlying mineral soil, cobbles, stones or bedrock; ▪ layers of decaying wood < 10 cm thick; ▪ large animal droppings; and ▪ areas covered by dead mats of graminoids or other vegetation (mats include L and F horizon materials),
Buried wood	The proportion of the ground surface covered by buried wood: ▪ class 5 woody debris with > 50% **below** the surrounding surface; ▪ does not include freshly fallen material that has yet to decompose; ▪ may be covered by mosses, lichens, liverworts, or other living plants; ▪ if an organic layer has developed over the wood, buried wood must be > 10 cm thick otherwise it is classed as "organic matter".
Decaying wood	Fallen trees, large branches on the ground surface, and partially buried stumps with an exposed edge: ▪ does not include freshly fallen material that has not yet begun to decompose (e.g. decay class 1 and 2 logs). Note that if there is a recently fallen class 1 or class 2 log blocking measurement, move the sample point to just beside the log (see anomalous conditions); ▪ may be covered with mosses, lichens, liverworts, or other living plants; ▪ if an organic layer has developed over the wood, decaying wood must have > 50% of its thickness **above** the surrounding surface, otherwise it is classed as "buried wood".
Bedrock	Bedrock includes exposed consolidated mineral material: ▪ may have a partial covering of mosses, lichens, liverworts, or other epilithic plants; ▪ does not qualify as bedrock if covered by unconsolidated mineral or organic material ≥ 1 cm in thickness.
Rock or cobbles and stones	Rock (cobbles and stones) includes exposed unconsolidated rock fragments > 7.5 cm in diameter: ▪ may be covered by mosses, lichens, liverworts; or an organic residue layer < 1 cm in thickness ▪ does not include gravels < 7.5 cm in diameter.
Mineral Soil	Unconsolidated mineral material of variable texture not covered by organic materials: ▪ may have a partial cover of mosses, lichens, and liverworts; ▪ often associated with cultivation, tree tip-ups, active erosion or deposition, severe fires, trails, or late snow retention areas; ▪ includes small cobbles and gravel < 7.5 cm in diameter; ▪ areas of living grass or forb cover where mineral soil is visible between stems are classed as mineral soil, as are exposed Ah or Ap horizons.
Water	Streams or areas of open water in bogs or fens. Note: this **does not include** "casual" or non-permanent water. The sample point should be recorded to reflect the conditions at the time of sampling, e.g. a gravel or sandbar below the high water mark for a stream would be recorded as mineral soil.

Forest Floor Sampling

Objectives

To collect four samples of the forest floor/litter layer which will be analyzed for total carbon and mineral content.

General Procedures

1. Establish the forage sampling micro-plots along the woody debris transects.

2. Excavate and sample the forest floor organic layer(s) from each of the four plots **or** at an equivalent, representative area nearby that is in or near the micro-plot.

Detailed Procedures

1. Establish the woody debris transects as per woody debris protocol.

2. Establish the four forage micro-plots at pre-assigned distances along the woody debris transects.

3. Select a suitable (level if possible and free of large organic debris) representative site within each of the four micro-plots. In very few instances, the sample may need to be located outside of the micro-plot if the location is physically obstructed.

4. At the selected site in an area approximately 30cm by 30cm remove all live vegetation (including bryophytes and lichens) and woody debris from the sampling area.

5. Using the 20 cm x 20 cm (inside dimensions), square aluminium template, cut out the forest floor layer (combined litter and humus) to the top of the mineral soil from each of the four micro-plots (see Appendix M for a complete list of field equipment). Use the hand saw or knife to accomplish this and be careful not to compress the soil sample underneath as this will affect its bulk density.

6. With a hand trowel, use inward scooping motions to remove the forest floor organic matter (L, F and H layers) taking care to remove all organic material above the mineral soil. Discard any rocks or pebbles collected with the forest floor material. It is beneficial to have a tarp or piece of thick plastic on which the sample materials can be placed as the sample is collected. This may avoid loss of parts of the sample.

7. Bag and label each forest floor sample separately in a 10-mm weight, plastic bag. Place a label in each bag identifying the sample number and micro-plot number and whether there is more than 1 bag for a sample (identify as 1 of 1, or 2 of 3, etc.).

8. Measure the average depth of the excavated surface organic matter or residue to the nearest 0.5 cm. In order to capture the average depth, make sure the depth is measured in several places in the excavated hole. Record the average depth of the forest floor layer on the tally card.

9. Note: the forest floor sample may be offset 0.5 m to 1.0 m from the transect to avoid trampling and disturbance of the plot for other measurements, e.g. shrub and herb

clipping and measurements, as long as the site chosen is representative of the site. The forest floor sample will also be offset if anomalous site conditions are encountered, e.g. a large ant hill, fallen sound wood. If the forest floor site is offset, clip and remove the fine wood and plants as per the normal micro-plot procedure.

Forest floor organics > 20 cm in depth

10. Collect the top 20 cm of surface organics on all four clip plots.
11. Collect and measure the total surface organics, in 20 cm thick intervals, to mineral soil / rock surface on **one** of the clip plots. This sample is necessary in order to get at least one bulk density measurement and sample for all depths of the surface organics.
12. Sampling of these sites should be conducted in the driest portion of the field season. The volume measurement of the organics will be obtained using the dimensions of the cut-out forest floor sample. No further excavations beyond the mineral / organic interface are necessary in instances where the organic layer extends beyond 60 cm in depth.
13. Note: there will be a large bulk of sample to bring back to the lab on these types of sites, e.g. the West Coast of Vancouver Island and North-Eastern parts of B.C.

Soil Bulk Density and Carbon Sampling

Objective

To collect seven, 1.0 to 1.5-Litre samples of mineral soil at approximate depths of 0 to 15 cm, 15 to 35 cm and 35 to 55 cm for each plot.

To measure the volume of each of the mineral soil samples extracted for the determination of soil bulk density. The samples will also be analyzed in the laboratory for carbon content, various mineral components, cat-ion exchange capacity, pH and other soil properties.

Definition

General Procedures

Establish the forage sampling micro-plots along the woody debris transects.

Excavate the bulk density soil samples from the soil pit and three additional sites at three of the four micro-plots **or** at an equivalent, representative area nearby that is in or near the micro-plot. The following samples are to be taken:

- At the soil pit take 3 samples
  - 1 sample from 0 to 15 cm
  - 1 sample from 15 to 35 cm
  - 1 sample from 35 to 55 cm
- At one of the micro-plots take 2 samples
  - 1 sample from 0 to 15 cm
  - 1 sample from 15 to 35 cm
- At two of the other micro-plots take 1 sample

- 1 sample from 0 to 15 cm

Detailed procedures

1. Upon cutting out the square forest floor layer at the soil pit, clear an area of the remaining organic material that is larger than the template (e.g. 50 x 50 cm) to begin excavation of the soil pit and samples.

2. Level an area about 20 x 20 cm and excavate a round hole inside the square for extracting the first soil sample. The hole should be approximately 12 to 15 cm in diameter (for a 15 cm deep sample) to allow for the extraction of at least 1.0 to 1.5 Litres of mineral soil. The minimum depth of the initial excavation should be 15 cm but could be adjusted to allow for sampling an entire layer.

3. During the excavation, extreme care must be taken not to compact the sides of the hole as this will affect the bulk density of the sample. A good way to avoid soil compaction during excavation is to always keep the handle of the trowel pointed in towards the centre of the hole, with the blade of the trowel pointing outwards.

Mineral soil sampling on sloped terrain

4. Note: as much as is possible, the soil bulk density sample should be taken on as level a surface as possible. In terrain located on a slope, the excavated hole should be located in the flattest location possible. This may mean clearing away a few centimetres of the Ae or Ah on one side to ensure a flat surface for sampling.

5. For the first excavation, measure the average depth of the hole after the few centimetres of Ae or Ah on one side have been cleared away.

6. Use glass beads or water for the volume measurement.

7. Note in the comments section that the depth measurement was taken on a slope and the percent of the slope.

Mineral soil sampling in sites abundant with coarse fragments

8. Note: if rocks (> 7.5 cm diameter, cobbles and stones) are encountered that take up more than ½ of the volume of the excavated hole, abandon the site and proceed with a new excavation in a different location. On sites where there are a lot of coarse fragments, this means that the initial excavation may take 2 or 3 tries before it is successful. An alternative to this method would be to excavate a larger diameter hole that captures the boundary of the coarse fragment(s).

9. Optional: to avoid having to carry the larger rocks removed from the hole, any adhering soil could be cleaned off the rocks and placed into the sample bag. The rock would then be weighed to the nearest gram. The volume of the rocks could then be estimated assuming rock to have a density of 2.65 g/cm3.

Mineral soil sample excavation and extraction

10. Extract the loose soil from the hole using the long-handled soup spoon and place in the 10-mm, heavy-duty bag.

11. Clean off the face of the hole using the hand-clippers or knife. All roots extending into the hole must be clipped and included in the sample.

12. Using your fingers or knife, smooth the surface of the hole and make sure there are no voids, e.g. where coarse fragments may have been extruding. If there are voids, the dimensions of the hole must be extended to accommodate a reasonably smooth surface.

13. Using the 5-mm weight plastic bag, line the hole and fill the bag with the glass beads (or water). Make certain the surface of the beads is flush with the top of the excavated hole.

14. Pour the beads (or water) into the 1.0-L graduated cylinder, measure the volume to the nearest 10.0 mL and record the information on the tally card. The volume of beads exceeding 1.0 L can be measured using the 100 mL cylinder for greater accuracy.

15. Mark the sample number, volume and depth on the tally card, label inside the sample bag and on the outside of the sample bag. If large rocks were removed from the sample, make note of their volume on the bag and the tally card also.

Mineral soil excavations for second and third samples

16. Pick a feature in the excavated hole that marks the depth of the excavation. A golf tee or aluminium nail may also be used to mark the depth. It is important to excavate samples at depths that are continuous with one another.

17. Clear an area (to the same depth) that is larger than the already excavated area (e.g. 50 x 50 cm) to allow for sampling at the next depth. This larger area can serve as the soil pit on one site that needs to be dug for pedogenic layer description and coarse fragment content estimation.

18. Perform the second excavation using the same method as the first excavation. The second excavation should be between 15 cm to 35 cm in depth and should be approximately 1.0 L to 1.5 L of mineral soil. Record the sample number (sample 278), depth (15 cm to 35 cm) and volume (1.6 Litres) of the second excavation on the tally card, place a label inside the sample bag, and on the outside of the sample bag.

19. Perform the third excavation also using the same method. The third excavation should be between 35 cm to 55 cm in depth and should equal 1.0 to 1.5 L of mineral soil. Record the sample number, depth and volume of the third excavation on the tally card, place a label inside the sample bag, and on the outside of the sample bag.

20. Note: the second and third excavations will require extra care and effort to obtain. The top layer of the initial excavation surface should be cleared to a broad and level surface (an area larger than the size of the 40 cm square) before successive deeper holes are excavated.

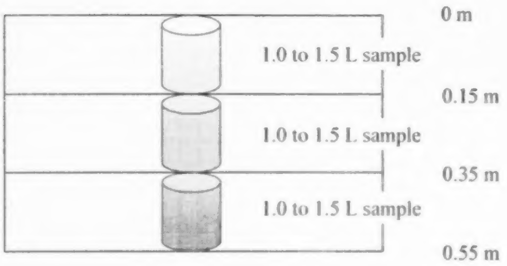


Figure 7.4 - Mineral bulk density excavation sample depths.

Importance of obtaining continuous mineral samples

21. The highest amount of carbon is located in the first and second excavations of mineral soil. For analysis purposes, it is important to obtain samples that are continuous with one another.

22. Due to site-specific reasons, excavating at the specified depth increments may not always be possible. If excavating at the specified depths is not possible still attempt to take three continuous samples at successive depths.

23. Make note of why taking the samples at the targeted depths was not possible on the tally card in the comments section. Ensure the depth that the sample was taken at is noted on the tally card, the label inside the sample bag and on the outside of the sample bag.

Distinguishing organic/mineral interfaces

24. Distinguishing the organic/mineral interface can be more difficult on sites with humus forms that are well-mixed, e.g. a Moder humus over an Ah layer.

25. Technically, a soil horizon is classed as mineral soil when it contains an organic carbon content ≤ 17% by weight. For field purposes, the determination is usually made by hand-feeling for the presence of mineral materials in order to judge the organic/mineral interface.

26. Where the determination is unclear, make a best judgment call in the field and then note it on the tally card in the comments section. Appropriate measures will be taken in the lab processing of the samples.

Unobtainable samples

27. If a sample was not obtained due to site-specific reasons, e.g. 'hit bedrock or site filled with large coarse fragments', label an empty bag and send this back with the samples that were successfully obtained.

28. Make sure to note why the sample was not obtained on the tally card in the comments section and the label inside the empty sample bag.

29. Sending an empty sample bag, with the reason the sample was not obtained in the field, ensures the lab staff are better able to keep track of the samples, e.g. the lab staff do not think that one of the samples was lost or is missing.

Quality Assurance of Bulk Density Samples

The bulk density procedures will involve destructive sampling. Extreme care must be taken in the sampling of mineral soils for bulk density measurements, as quality assurance for these procedures will not be possible.

It is suggested that the field crew member performing the bulk density sampling procedures perform a dozen practice excavations before the actual data collection to ensure that consistency of methods is achieved.

Bulk Density Sampling in Organic Sites/Soils

Bulk density sampling in organic soils will not be conducted this field season.

7.4 Describing Vegetation

Species Coding System

There are a number of taxonomically difficult plants which need only be identified to the level of genus. In the interests of saving time, you are not required to identify these plants to the species level. However, if you know the species and/or time permits, you are encouraged to record these genera to the species level.

In general, species codes consist of the first 4 letters of the genus and the first 3 letters of the species The most current plant species codes and descriptive information is available at the following website:

http://www.for.gov.bc.ca/hre/becweb/standards-species.htm

However, there are a number of instances which would result in the same code for two different species. For example *Vaccinium myrtilloides* and *Vaccinium myrtillus*. The species that comes first alphabetically is assigned the standard code, and the last letter of the code for the second species defaults to the fourth letter in that species' name. Thus *V. myrtilloides* = VACCMYR _ and *V. myrtillus* = VACCMYT _. This is a potentially serious error, which may be impossible to detect or correct. You must refer to master lists provided for the biogeoclimatic units in your project area, to ensure the code you use is correct.

If the genus is known but not the species, record all the characters (up to 7) in the genus. For example, if an unknown lichen of the *Cladonia* genus is collected, it is coded as CLADONI _. A grass of the *Poa* genus would be coded as POA _ _ _ _ _. If the grass is known to be *Poa alpina*, it would be coded as POA_ALP _.

If you are uncertain of genus but know the plant family, record the first 6 letters of the family name, and collect a specimen for determination. As an example, several species from the sunflower family could be recorded as ASTERA1 and ASTERA2, rather than as HERB1 and HERB2.

Assuming the species is unknown, use the following coding priority for vascular plants:

- genus > family > non-Latin code such as "FERN."

Since family names are not as widely documented for lichens, liverworts, and mosses, the coding priority for these non-vascular unknown species is:

- genus > non-Latin code such as "MOSS" (see Table 7.16).

As a general rule, the non-Latin unknown code uses 4 letters (MOSS), the family code uses 6 (ASTERA), and the genus code uses 7 (VACCINI) or fewer if there are not 7 available (POA, CAREX, SALIX).

Although not encouraged, an 8-character code may be used for special purposes to distinguish a variety or subspecies. For example, PINUCON1 versus PINUCON2, to differentiate *Pinus contorta* var. *contorta* (shore pine) from *Pinus contorta* var. *latifolia* (lodgepole pine).

Table 7.16 – Suggested coding conventions for collected unknown species.

Code*	Description
"genus"	code first 7 letters of genus
"family"	code first 6 letters of family
TREE	coniferous or deciduous tree
SHRU	coniferous or deciduous shrub
SEED	coniferous or deciduous seedling
HERB	herb (catch-all for herb-layer species)
LYCOPO *or* CLUB	clubmosses belong to one family "Lycopodiaceae" clubmoss
SELAGIN	lesser-clubmosses belong to one genus "*Selaginella*"
EQUISET *or* HORS	horsetails belong to one genus "*Equisetum*" horsetail
FERN	fern
GRAM	graminoid (grass, rush or sedge)
POACEA *or* GRAS	grasses belong to one family "Poaceae" grass
JUNCAC	rushes belong to one family "Juncaceae"
or RUSH	rush
CYPERA *or* SEDG	sedges belong to one family "Cyperaceae" sedge
SAPR	saprophyte or parasite
LICH	lichen
LIVR	liverwort
MOSS	moss

*CODE – add numbers to the codes for multiple samples.
For example, CLADONI3, CAREX2, CYPERA3, VIOLAC2, HERB3, LIVR2, MOSS4.

Collecting Unknown Species and Voucher Specimens

1. Collect a sample for any species you cannot identify in the field for which you should record a percentage.

   Depending on the project, Voucher Specimens may be required. *Voucher Specimens* are samples collected, preserved, and stored to later verify identifications made in the field.

   - For trees, low shrubs, and tall shrubs, collect representative samples of flowers, fruits/cones, bark, a branch with leaves (needles) showing branching patterns. Record the height of plants when they are not collected as an intact specimen; this would obviously apply to trees and most shrubs.
   - For herb-layer species collect the entire plant or as much of the plant as feasible, including roots and, in particular, any flowering structures.
   - For mosses and lichens, collect a "palm-of-the-hand" size sample. Try to include moss capsules, lichen apothecia.

2. The following points will ensure good-quality specimens:

   - Use appropriate containers: paper bag, envelopes, plastic bags (allow air in occasionally).
   - Press or process as soon as possible.
   - Keep different genera separated.
   - Keep mosses/lichen samples separated and un-pressed to maintain their three-dimensional form.
   - Cross-reference to item number on field card.
   - Collect specimens from outside the plot area, if possible.

3. Complete a waterproof plant label: for each plant sample being forwarded for identification (Fig. 7.5). Concentrate on microsite conditions directly associated with the plant, rather than duplicating general habitat or site information for the larger sample plot.

Typical plant microsite habitat information:

- soil or substrate conditions (humus, decaying wood, fibric organic soil, coarse- or fine-textured mineral soil, disturbed or recently mixed soil, SMR and SNR conditions, salinity)
- drainage (seepage track, stream or pond margin, depressional hollow or shedding mound)
- exposure and other physical factors (growing in open exposed or in relatively protected/shaded conditions, in an avalanche or a slide track, exposure to periodic or frequent flooding from standing or moving water).

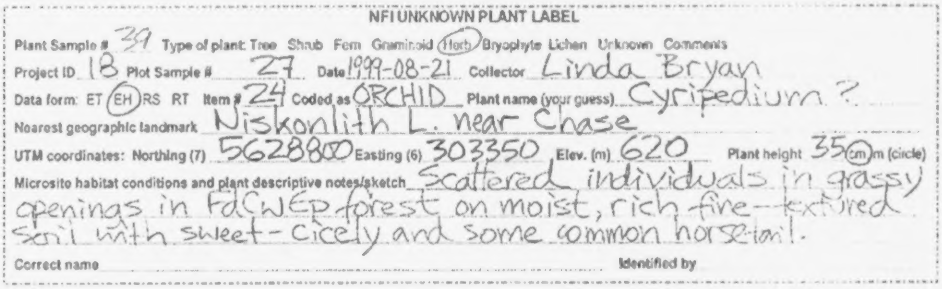
Record only the most applicable microsite conditions, such as in these examples: "associated with an exposed seepage draw in saturated nutrient-poor organic soil; growing in steep well-drained mor humus beneath a large canopy gap; on disturbed sandy mineral soil associated with overturned tree roots; in a rocky south-aspect grassy patch with coarse well-drained dark soil."

In the descriptive notes, include diagnostic characteristics which may not be obvious from a casual look at the dried and/or pressed specimen. Here are some examples of useful additional descriptive information:

- distribution and abundance (solitary individuals in a scattered pattern; common and growing in small clumps; several large clumps within the plot; continuous coverage)

- leaves (leaves feel slightly sticky; fresh leaves have a cucumber scent when crushed; blades have an undulating margin)
- associated species (with skunk cabbage and lady fern; within clumps of *Cladonia spp.*, in patches with *Veratrum*, *Fauria* and *Sphagnum*)

Keep documentation on the labels as concise and applicable as possible. Do not allow labels to become separated from their relevant plant samples.



NFI UNKNOWN PLANT LABEL

Plant Sample # 39 Type of plant: Tree Shrub Fern Graminoid [✓ Herb] Bryophyte Lichen Unknown Comments

Project ID 18 Plot Sample # 27 Date 1999-08-21 Collector Linda Bryan

Data form: ET [✓ EH] RS RT Item # 24 Coded as ORCHID Plant name (your guess) Cyripedium ?

Nearest geographic landmark Niskonlith L. near Chase

UTM coordinates: Northing (7) 5628800 Easting (6) 303350 Elev. (m) 620 Plant height 35 [✓ cm] m (circle)

Microsite habitat conditions and plant descriptive notes/sketch Scattered individuals in grassy openings in FdCwEp forest on moist, rich fine-textured soil with sweet-cicely and some common horsetail.

Correct name

Identified by

Figure 7.5- NFI Unknown plant label.

Plant Identification

As a guideline, you should not need to spend more than 10 minutes per plot checking your plant identification references. If you cannot quickly identify the plant, collect it.

Identify Vascular Plants to the Species Level

Identification of vascular plants (tree-, shrub-, and herb-layer) should be carried to the species level.

Identify Non-vascular Plants to Genus Level

Identification of bryophytes and lichens need only go to the genus level. Alternatively, if the species is known or if there is enough time to sample, you are encouraged to carry on to the species level. If you are uncertain about the genus, you should sample anyway.

Recommended Procedure for Identification of Collected Plants

1. Time permitting, identify collected plants in the evening if this can be done efficiently.

If identification of unknown samples is not possible within a designated time, the identifications should default to genus or possibly a higher taxonomic level, such as family. Specimen quality or developmental stage may also limit identification to a higher taxonomic level. In any case, the final database entry must be the correct code for the particular taxonomic level.

Unknown Species Coding

Please use the unknown species coding conventions listed in Table 7.16, as this will help simplify interpretation of the unknown coding on the forms. You are encouraged to continue recording your descriptive notes for unknown species in the comments section on the ET and EH forms, as this will help you remember the species when you determine its cover value, and later when you key the plant or store it for identification.

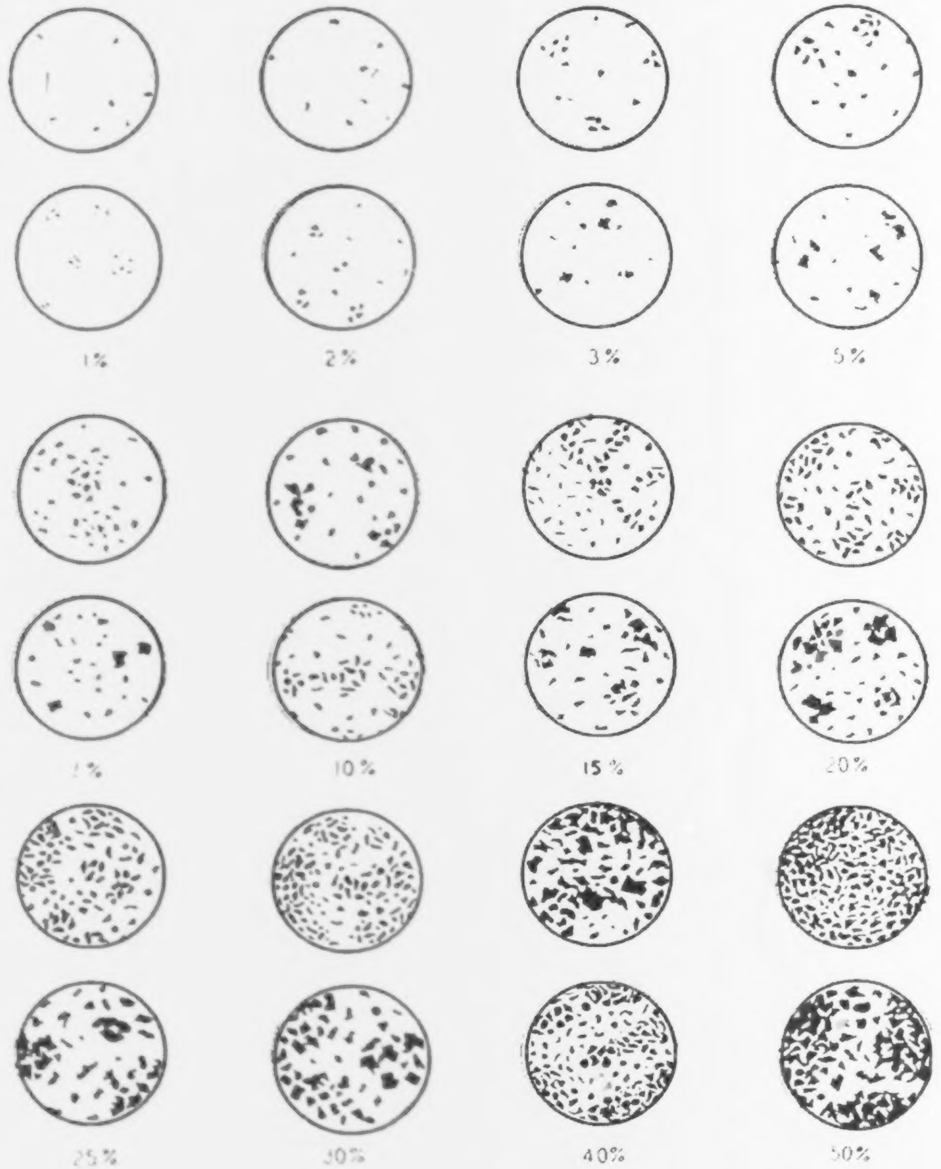
These codes are normally temporary if the plant has been collected for identification, and they should be replaced on the forms and in the database with the correct Latin codes upon receiving results.

26. SPECIES CODES

1. Record all shrub and tree species growing in the 10 m radius plot, and all herbs and bryoids growing on the dominant substrate within the nested 5.64 m radius plot, using codes based on the scientific names. A list of scientific names with codes will be provided by a local ecologist for an inventory project. Collect samples of any unknown species, bag and label them for later identification by specialists. Record the item number from the field card on the tagged plant sample as a cross-reference.
2. Maintain a systematic method of recording the species in the plot. The results are much easier to read and compile. One common method is to record species by strata, starting with the uppermost stratum, and within strata by abundance.
3. In some circumstances it may be necessary to collect the plant list at another time of the year to take advantage of peak floristic conditions.
4. Certain ecosystems are more difficult to sample (for example, alpine, subalpine meadows, wetlands, riparian edge communities, grasslands, rock outcrops, and disturbed sites with introduced weedy and non-native species). It may be necessary to have these plots sampled by specialists.

Estimating Percent Coverage by Layer

Percent canopy cover is the percent of the ground area covered by a vertical projection of the crown of the plant onto the ground surface. When estimating percent cover, care must be taken not to bias estimates because of crown density. Except for distinct holes in the crown, the area within the perimeter of the crown is assumed to be fully covered. It is required that percent cover be recorded for each species in each plot. To aid in assessing percent cover, a set of comparison charts are provided in Figure 7.6. Table 7.18 also provides examples of the area coverage and the percent cover for the plot. Figure 7.7 illustrates some relative amounts of percent canopy coverage and shows the "drip line" of the plant.



Developed by Richard D. Terry and George V. Chillinger. Journal of Sedimentary Petrology 25(3): 229 – 234, September 1955

Figure 7.6 - Comparison charts for visual estimation of foliage cover.

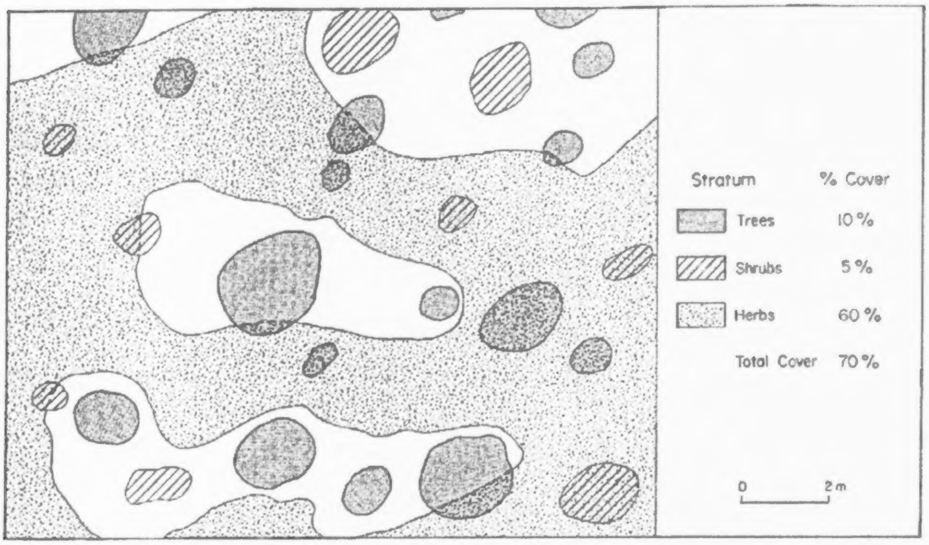


Figure 7.7 - An example of percent coverages in a plot, viewed from above.

Percent cover is estimated as the percentage of the ground surface covered when the 'crowns' of the plants are projected vertically. The values are estimates that will vary somewhat between individuals, however, the relative cover values are required to provide information on species abundance.

With regards to species of very low coverage, you are not expected to produce an exhaustive list. It is easy to overlook a few species given the seasonal variation in flowering and vegetative production. Species of very low coverage, less than 0.1 percent can easily be missed by anyone. Save time and energy by focusing on the main substrate, which in most forested ecosystems is the forest floor, as discussed in item 4 below.

1. Initially, record an estimate of overall coverage (in percent) in each layer (all species), excluding any overlapping. Use this figure to help calibrate cover estimates for individual species.
2. Estimate the coverage for each species in the tree and shrub layers within the 10 m radius plot.

   Estimate the coverage within the nested subplot (5.64 m radius)

   - for seedlings (ET card)
   - for herbs and mosses (EH card)

   For calibration, Table 7.18 (conversion factors) shows the equivalent area for percent cover when applied to the 10 m radius main plot and 5.64 m radius nested plots.

3. If the total of individual species percentages in a layer is less than the overall total, adjust cover estimates for individual species or totals.

If the cover of a species overlaps within a strata, then the total percentage may be considerably less than the sum of individual layer coverages, but never more. **Do not sum the individual cover values to compute the overall coverage.**

Vegetation layers are listed in Table 7.17 and in Figure 7.8.

4. The D layer consists of mosses, lichens, liverworts, and seedlings. Three main substrates are recognized in Layer D:
   - Dh (on forest floor and mineral soil)
   - Dw (on decaying wood)
   - Dr (on rock)

In Layer D emphasize species growing on the main substrate, which in most cases will be Dh (forest floor or mineral soil). Describe the species on atypical substrates (for example, Dw – decaying wood, and Dr – rock) only when these substrates individually represent 40% or more of the 5.64 m vertically projected plot surface. If present, forest floor (Dh) species should always be described, because they are often important indicators of soil conditions.

Table 7.17 – Vegetation layer codes.

Layer	Description
A	**Tree layer:** includes all woody plants greater than 10 metres tall. Estimate cover values for individual tree or shrub species for the entire A layer. Overlapping crown is not additive for the same species, consequently a given tree or shrub species cannot have coverage greater than 100%.
B1	**Tall shrubs:** includes all shrubs and advanced tree regeneration between 2-10 m tall. In some low productivity and young ecosystems the canopy of mature trees may be less than 10 m tall and should be recorded in the B1 layer.
B2	**Low shrubs**: consist, with minor exceptions, of shrubs and established tree regeneration less than 2 m tall and at least 2 years old.
C	**Herbs:** refers to herb-layer plants such as ferns, graminoids, forbs, saprophytes, and some woody Species. Appendix H provides a list of low woody species and species of doubtful lifeform assigned to the herb (C) layer.
D	**Mosses, lichens, liverworts and seedlings:** includes tree seedlings less than 2 years old.

Table 7.18 – Conversion factors from percent coverage to horizontal area.

Percent coverage	10 m radius plot	5.64 m radius plot
Horizontal surface area	314 m^2	100 m^2
25% coverage	¼ of the plot pie or 78.5 m^2	¼ of the plot pie or 25 m^2
1% coverage	1.8 m × 1.8 m or 3.14 m^2	1 m^2
Note: You are not required to record genera or species with less than 1% coverage.		
0.1% coverage	~ 55 cm × 55 cm or 0.31 m^2	~ 32 cm × 32 cm or 0.1 m^2
0.01% (1H* – hundredth of a percent)	~ 18 cm × 18 cm or 314 cm^2	~ 10 cm × 10 cm or 100 cm^2
0.001% (1T* – thousandth of a percent)	~ 6 cm × 6 cm or 31.4 cm^2	~ 3 cm × 3 cm or 10 cm^2
*1H and 1T, or multiples (3H, 5H, 2T, 9T . . .), allow for better estimates for species with very small coverage. Note that 9H or 9T is the maximum since 10H = 0.1% and 10T = 1H. "~" means approximately		

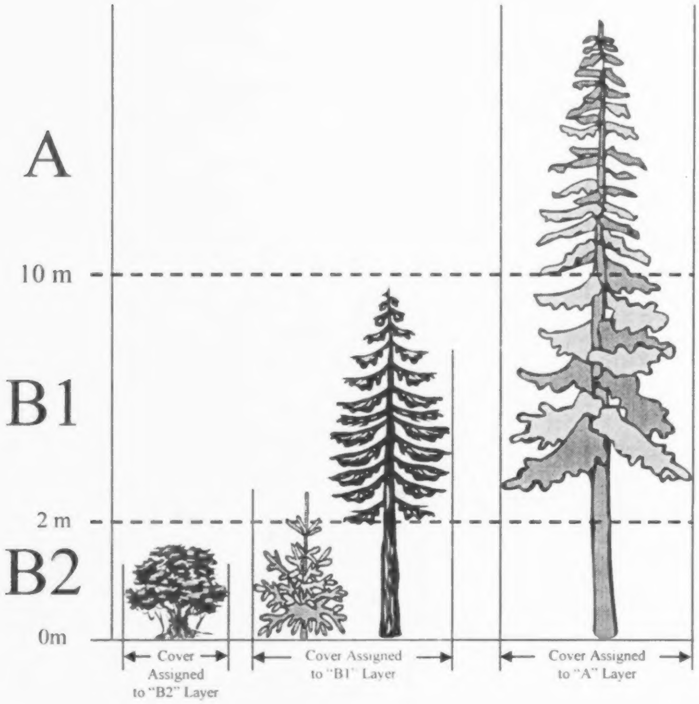

A
10 m
B1
2 m
B2
0m
Cover Assigned to "B2" Layer
Cover Assigned to "B1" Layer
Cover Assigned to "A" Layer

Figure 7.8 — Taller Vegetation Layers.

Estimating Average Shrub Height

27. AVERAGE SHRUB HEIGHT B1 (M) AND B2 (M)

The height and the percent cover estimates will be used to calculate shrub volume by species.

1. Record the mean height, weighted by percent cover, for each species in shrub layers. Include all woody shrubs as well as trees in the shrub layers.

EXAMPLE

The following calculation provides the weighted average for a stand of Douglas maple 3 m tall covering 30%, with one 8 m tall shrub covering 10%.

Cover-weighted average height $= \Sigma \text{ (height} \times \text{cover)} / \Sigma \text{ cover}$

$$= \frac{(3m * 0.3) + (8m * 0.1)}{(0.3 + 0.1)}$$

$$= \frac{(0.9m + 0.8m)}{0.4}$$

$$= \frac{1.7m}{0.4}$$

= 4.2m (round down to nearest 0.1m)

2. There is not enough time to calculate the weighted average in the field, and you are not expected to do it. Develop a quick visual estimate of average species height, weighted by coverage.

7.5 Interpreting Succession

Successional interpretations are based on an area within approximately 25 m of the Integrated Plot Centre, and within the 11.28 m plot. As the sample may cover more than one land cover type the succession interpretation which best describes the IPC location is to be recorded.

1. Record data on the EO Field Card using appropriate codes.
2. Identify factors influencing vegetation, including previous and current tree species, and structural class of the area surrounding the Integrated Plot Centre.
3. Assess the factors used to determine old growth characteristics of the stand, and estimate the percent of old trees remaining.
4. Decide whether the stand is old growth or not.
5. If not old growth, decide whether the stand has some old-growth characteristics.

28. FACTORS INFLUENCING VEGETATION ESTABLISHMENT

Record the major observable factors that are relevant to development of the current vegetation and soil characteristics. The time frame is (approximately) the past 500 years. Use from one to a maximum of four of the categories shown in Table 7.19. Only record factors for which direct evidence can be observed.

Use a 2-character description (such as Aw), or a 1-character description (such as A __) if the specific factor is unknown.

Leave the field blank if no evidence can be observed.

Table 7.19 is adapted from the *Field Manual for Describing Terrestrial Ecosystems* draft, 1996. Table 7.20 provides a more detailed description of certain factors – marked *.

Table 7.19 – Site disturbance codes.

Code		Description
A	**Atmosphere-related effects**	
	e	climatic extremes (extreme cold and/or heat; glaze ice, hail, heavy snow)
	p	atmospheric pollution (toxic gases, acid rain)
	w	windthrow*
B	**Biotic effects (specify animal or plant in comments)**	
	b	beaver tree-cutting*
	d	domestic grazing/browsing
	e	excrement accumulation (other than that normally associated with grazing/ browsing)
	i	insects (infestation, kill)*
	p	disease (excluding insects)*
	v	aggressive vegetation
	w	wildlife grazing/browsing (specify animals)
D	**Disposals**	
	c	chemical spill or disposal
	e	effluent disposal
	g	domestic garbage disposal
	m	mine spoils
	o	oil spill or disposal
	r	radioactive waste disposal or exposure
F	**Fires**	
	c	overstorey crown fire*
	g	light surface (ground) fire
	i	repeated severe surface fires (intense)
	l	burning of logging slash (broadcast burn, piled and burned, burned windrows)
	r	repeated light surface fires
	s	severe surface fire*
L	**Forest harvesting**	
	a	patch cut system
	c	clearcut system (if slash burned, see also Fires)
	d	seed tree system (uniform, grouped)
	e	selection system (group selection, strip, single tree)
	l	land clearing (includes abandoned agriculture)
	o	coppice
	s	shelterwood system (uniform, group, strip, irregular, natural, nurse tree)

Code		Description
M		**Plant or site modification effects**
	c	herbicide (chemical) use
	f	fertilization
	g	seeded or planted to grasses
	h	seeded or planted to herbs
	i	irrigation
	s	planted or seeded to shrubs
	t	planted or seeded to trees
P		**Gathering or removal of plant products**
	f	firewood gathering
	m	mushrooms
	o	moss
	s	salal
	x	other (specify in comments)
S		**Soil disturbance**
	a	cultivation (agricultural)
	c	compaction
	e	excavation
	f	sidecast/fill
	g	gouging (> 5 cm into mineral soil)
	m	mining effects (placer tailings, rock quarrying, open pit mines, tailings)
	p	mechanical site preparation (brush blading, scarification, trenching, mounding)
	r	road bed, abandoned
	s	scalping (forest floor removed)
	t	railway, abandoned
T		**Terrain-related effects**
	a	avalanche
	d	recent deglaciation
	e	eolian (active soil removal or deposition by the wind)
	s	terrain failures (active/recent slumps, slides, solifluction – soil creeping)
	v	volcanic activity
W		**Water-related effects**
	d	water table control (diking, damming)
	e	water table depression (associated with extensive water extraction from wells)
	i	inundation (including temporary inundation resulting from beaver activity)
	s	temporary seepage (usually man-induced; excludes intermittent seepage resulting from climatic conditions)
X		**Miscellaneous (for further disturbance types, enter "X" and describe in comments)**
*Indicates additional information in Table 7.20		

For certain factors shown in Table 7.19, further details are provided in Table 7.20.

Table 7.20 – Indications of site disturbances.

Signs of windthrow

- trees may be uprooted or snapped along the bole
- may lie parallel to each other if in patches
- stands arising after extensive windthrow will have mounded terrain

Signs of clearcut logging

- scattered, large stumps of similar species, size condition
- evidence of saw cut or felling machine cut on stumps
- CWD may be of a few large logs from previous stand and smaller material from mortality in new stand
- new growth will contain trees of fairly uniform DBH/height

Signs of selective logging

- scattered larger stumps, possibly of the same species
- skid trails will be visible
- larger trees of the logged species should still be present
- do not confuse with small clearcut

Signs of surface fire

- larger CWD will be charred or partially burned
- standing trees will have charred lower boles, and crowns raised (crown scorch)
- lower crown foliage discoloured (recent fire)
- dead or dying smaller trees in the understorey (recent fire)
- fire scars on larger trees (basal wound with a burned catface) if surface fires common in area

Signs of overstorey crown fire

- most trees dead; most of their foliage gone and some small twigs
- bark charred (recent); bark shed, leaving silvery snag (older)
- soil organic layer consumed to various degrees
- tree roots exposed near boles
- charred debris present

Signs of beaver tree-cutting

- stumps show chipping and conical tops
- bark may be removed from larger branches
- primarily hardwood trees and willowy shrubs

Signs of disease

- symptoms specific to each agent (cankers, rusts, mistletoes, blights, root diseases)
- swellings on branches or boles
- dead leaves, needles, bark, tops
- resin flows, galls, brooms

- distress cone crops and fruiting bodies on various parts

Signs of Insects

- symptoms specific to each type (defoliators, sucking insects, woody tissue feeders)
- foliage discolouration to foliage loss
- curled twigs, branch galls, crown distortion
- stunted or deformed leaders

Signs of snow avalanching

- tracks (if fairly frequent); shrub and herb species instead of trees (in tracks)
- broken branches, snapped boles, piles of debris
- windthrow or pushed over trees
- forests affected may be on slope beside or between tracks or in valley floor below runout zone

Signs of slope failures

- sharp boundaries with remaining forest (severe)
- upper portion consists mostly of exposed mineral soil
- lower portion composed of soil, rock and forest debris
- debris forms mounded or lobed pattern
- trees dead, displaced or leaning
- older failures show decreasing mineral soil and increased organic matter
- slow regeneration of trees

29. TREE SPECIES SUCCESSION

1. In forested ecosystems look for signs of the earlier predominant tree species. The primary species has the greatest basal area.
2. Record previous and current predominant tree species with the appropriate code. For example, in a red alder stand with western hemlock and western red cedar stumps, record "previous species" as Hw _ Cw _, and "current species" as Dr _. Alternatively, if the stand is, and appears to have always been Bl _ Se _, simply record as Bl _ Se _ in both previous and current species boxes.
3. If stumps are present but they are unidentifiable, record the appropriate code for: Unknown (X _ _), Unknown hardwood (Xh _), Other hardwood species (Zh _).

Stand Structure Features

Evidence for the decision as to whether or not the stand has some old growth characteristics will be based on the following set of observations.

30. TREE HARVESTING

Record if the forest has experienced some form of harvest:

Clearcut	C	Partial	P	None	N

31. SNAGS > 25 CM DBH

Count the standing dead trees within the 25 m radius that meet the minimum size criteria: >25 cm DBH and >10 m tall or shorter due to advanced stage of decay (for example, wildlife tree classes 7 to 9).

None 0	N	Some 1–5	S	Common > 5	C

32. SNAGS/CWD IN ALL SIZES AND STAGES OF DECAY

Assess the range of size and decay stage of the snags and CWD and record using codes in Table 7.21. This observation is meant to identify those sites where snag and coarse woody debris recruitment is an ongoing process.

Table 7.21 – Snags/CWD codes.

Code	Description
N	**No** No snags that meet the minimum size criteria, or all snags are within a narrow range (1 or 2) of decay classes; CWD absent or limited to a narrow range of decay classes.
S	**Some** Snags meet the minimum size criteria but are limited to 3 consecutive decay classes; CWD limited to 3 consecutive decay classes.
Y	**Yes** Snags meet the minimum size criteria and represent most decay stages; CWD in most decay classes.

33. CANOPY GAPS DUE TO TREE MORTALITY

Gaps are openings, caused by natural tree mortality, which are not yet occupied by A3 layer (>10 m tall) or equivalent trees. Mortality refers to natural causes of death; for instance trees have blown over, snapped off, or died standing.

1. Record gaps in the canopy that are due to natural tree mortality using codes in Table 7.22.
2. Do not count gaps if the cause of death appears to be related to harvesting or other human activities. It may be hard to decide, for example, where death is due to fire or other damage that could be related to human activities.
3. Do not include openings due to climatically drier or otherwise harsh regimes where trees are widely spaced. This also does not include natural stocking irregularities which may be caused by edaphic factors such as shallow soils, bluffs or rock outcrops, seepage or stream channels, wet depressional sites, colluvium, slide or avalanche tracks, snow accumulation patches, landings, trails, and roads.
4. Do not include successionally young sites where trees have not yet grown into the A3 layer.

Table 7.22 – Canopy gap codes.

Code	Description
N	**None** No apparently natural gaps.
S	**Some** Smaller gaps amounting to <10% of crown closure in 25 m area.
C	**Common** One or more larger gaps occupying 10% or more of the potential canopy area.

34. VERTICAL STRUCTURE

Describe the distribution of shrub and tree layer strata using Figure 7.9 and Table 7.23.

Table 7.23 – Vertical structure codes.

Code	Description
S	**Simple** Tends to be even-height, with limited coverage in up to two other strata (B2, B1, A3, A2, or A1).
M	**Moderate** Tends to be uneven height with >10% of total coverage in each of three strata (B2, B1, A3, A2, or A1).
C	**Complex** Stand is uneven-height with >10% of total coverage in each of four or five strata (B2, B1, A3, A2, and A1).

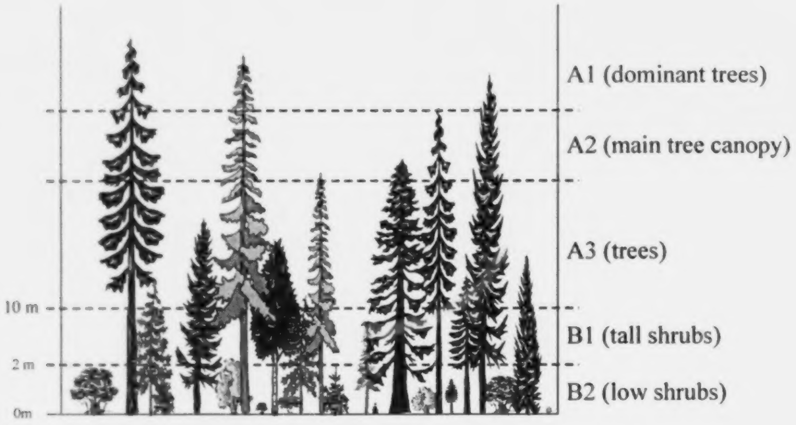


Figure 7.9 – Stratification of forest stands, shrubs, and trees.

35. SUCCESSIONAL STABILITY

Assess whether the dominant species composition is relatively stable and record the appropriate code from Table 7.24. We need to know if there is likely to be change in species composition of the dominant vegetation. It is important to consider the potential of a given species in a particular site.

For example, in a MH_ _wh_ subzone plot there may be frequent Hw __ and Cw __ in the understorey, but observations on the way to the plot suggest that in spite of their shade tolerance, few, if any, Hw __ and Cw __ survive into the main canopy, which is occupied by Hm __, Yc __ and some Ba __.

Table 7.24 – Successional stability codes.

Code	Description
U	**Unstable** Change in dominant species composition is imminent. Clues are recently disturbed sites, early structural stages, or presence of shade-intolerant (pioneer) species for the given site. With no apparent sign of a short cyclic major disturbance regime (floods, slides, windthrow, fire, disease) the vegetation will likely progress unimpeded to more advanced structural stages, with changes in dominant species composition along the way. Unstable means that the relative rate of change is rapid (on the order of less than 40 years).
I	**Intermediate** Change in species composition has and will continue to take place in the dominant vegetation. The longevity of the species involved is such that the relative rate of change in composition is gradual, but directional (on the order of 40 — 80 years).
S	**Stable** Persistence in dominant species composition is apparent from factors such as advanced structural stage, occupation by shade-tolerant species, or when the rate of change in the dominant species composition is relatively very slow (stable for more than 80 years). Even relatively young dominant vegetation may qualify as stable if there is little sign of change in species composition. For example, an avalanche track dominated by slide alder would be considered stable if disturbance appears to be frequent enough to maintain the alder. Likewise a young shade-tolerant Hw __ stand that is unlikely to undergo much change in dominant species composition as its canopy gains height and structural complexity, would also be considered stable.

36. TREE AGE FOR SPECIES AND SITE SERIES

Assess whether the trees appear old for their species and the site conditions, and record one of the codes shown in Table 7.25.

Because few tree ages are being collected, this will be difficult to determine. Even-aged stands will tend to be the easiest to evaluate. In a stand with differing tree ages, assigning an approximate age for the trees dominating the site will be difficult. Concentrate on the trees that dominate the canopy.

Table 7.25 – Stand age codes.

Code	Description
Y	**Young** Characteristic of even-height forests in the young forest or earlier structural stages.
I	**Intermediate** Species may have attained near-maximum height, but there is little mortality in the main to upper canopy as the species are only in a mature forest stage.
O	**Old** Trees in the upper canopy have been established for a relatively long time. Some upper canopy trees appear to have reached their physiological maximum age. Others may already have died.

37. TREE SIZE FOR SPECIES AND SITE

Evaluate the size of the trees on the plot, relative to the potential size expected for the site quality, amount of disturbance, and growing time. Relatively larger trees will obviously tend to be found in the less disturbed, older stands. Even-aged stands will be easier to evaluate.

Small	S	Intermediate	I	Large	L

38. STRUCTURAL STAGES

Evaluate the stand and record one of the codes shown in Table 7.26. Note that, depending on the climatic conditions and the site properties, the length of time required to reach mature and/or old forest stages varies considerably.

Table 7.26 – Structural stage codes.

Code	Structural Stage	Definition	Time since major disturbance[1]
NV	**Non-vegetated**	Less than 5% vegetation cover	<20 years for normal forest succession. Up to 100+ years for rocky or bouldery substrates and other severe sites.
SP	**Non-vegetated or Sparse**	Initial stages of primary and secondary succession. Little or no residual vegetation except up to 100% cover of bryophytes and lichens. Less than10% cover of vascular plants. This stage may be prolonged (50 — 100+ years) where there is little or no soil development (bedrock, boulder fields).	
H	**Herb**	Early successional stage or restricted development due to environmental conditions or disturbance (snow fields, avalanche tracks, wetlands, flooding, grasslands, intensive grazing, intense fire damage) dominated by herb-layer (forb, graminoid, fern) vegetation;	<20 years for normal forest succession. Up to 100+ years under conditions of soil, climate, or disturbance which limit succession.

Code	Structural Stage	Definition	Time since major disturbance[1]
		some invading or residual shrubs and trees may be present. Tree cover <10%, shrub cover <20% or <33% of total cover, herb-layer cover ≥20%, or ≥33% of total cover.	
LS	**Low Shrub**	Early successional stage or restricted development due to environmental limitations and conditions, dominated by shrubby vegetation <2 m tall. Seedlings and advance regeneration may be abundant. Tree cover <10%, shrub cover ≥20% or ≥33% of total cover.	
TS	**Tall Shrub**	Early successional stage or restricted development due to environmental limitations and conditions dominated by shrubby vegetation > 2 m and < 10 m tall. Seedlings and advance regeneration may be abundant. Tree cover <10%, shrub cover ≥ 20% or ≥ 50% of total cover.	<40 years for normal forest succession. Up to 100+ years under conditions of soil, climate, or disturbance which limit succession.
PS	**Pole/ Sapling**	Trees >10 m tall, have overtopped shrub and herb layers and stands are typically densely stocked; younger stands are vigorous and usually > 10–15 years old. Older pole-sapling stages composed of stagnated stands (up to 100 yrs. old) are also included. This stage persists until self-thinning and vertical structure becomes evident in the canopy (often by the age of 30 yrs. in vigorous deciduous stands). Deciduous stands are generally younger than coniferous stands belonging to the same structural stage.	< 40 years for normal forest succession. Up to 100+ years for dense (> 2,000 stems/ha.) stagnant stands.
YF	**Young Forest**	Self-thinning has become evident and the forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the pole-sapling stage; begins as early as age 30 and extends to 50 — 80 years depending on tree species and ecological conditions.	40 — 80 years
MF	**Mature Forest**	Trees established after the last disturbance have matured and a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up.	80 — 140 yrs. for Biogeoclimatic group A[2] 80 — 240 yrs. for Biogeoclimatic group B[3]
OF	**Old Forest**	Old, structurally complex stands comprised mainly of shade tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition are typical and understories are patchy. In some	>140 yrs. for Biogeoclimatic group A[2] >240 yrs. for Biogeoclimatic group B[3]

Code	Structural Stage	Definition	Time since major disturbance[1]
		ecosystems, such as high elevation, or otherwise stressed, the understorey may have a number of tree species which are uncommon in the canopy, due to the inherent limitations of these tree species under the given conditions.	
[1]Structural characteristics have priority over time guidelines)			
[2]BGCU Group A includes the following: BWBSdk, BWBSmw, BWBSwk, BWBSvk, ESSFdc, ESSFdk, ESSFdv, ESSFxc, ICHdk, ICHdw, ICHmk1, ICHmk2, ICHmw1, ICHmw3, MS, SBPS, SBSdh, SBSdk, SBSdw, SBSmc, SBSmh, SBSmk, SBSmm, SBSmw, SBSwk1 (on plateau), and SBSwk3.			[3]BGCU Group B: All other biogeoclimatic units.

39. PERCENTAGE OF LIVE OLD TREES REMAINING

Assess the proportion of live old-growth trees by examining the numbers of dead and living old forest or old-growth trees (see table 7.26 Old Forest structural stage ages for your biogeoclimatic unit: for example, in the MS zone trees > 140 years are old growth trees, or their remains, in the form of snags, fallen trees, or stumps to support your estimate. This is not an estimate of the number of live old trees versus an imaginary potential number of old-growth trees. For example, if the 25 m radius area has evidence of 10 old trees and only 3 are still alive and standing, the value would be 30%.

Examples:

$$\frac{\text{2 old trees}}{\text{(2 old trees + 0 old tree snags + 0 fallen old trees + 0 stumps)}} \times 100\% = 100\%$$

$$\frac{\text{0 old trees}}{\text{(0 old trees + 2 old tree snags + 1 fallen old trees + 3 stumps)}} \times 100\% = 0\%$$

$$\frac{\text{3 live old trees}}{\text{(3 live old trees + 2 dead old trees + 5 stumps of old trees)}} \times 100\% = 30\%$$

If the percentage of live old trees remaining is less than 40%, the site is probably too disturbed for the old growth forest designation.

40. OLD-GROWTH FOREST

Base your choice on your opinion using all the succession attributes discussed above. "No (some)" suggests the stand has *some* old growth forest attributes, but it is not old growth.

Record one of the following:

No	No (some)	Yes

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8. Woody Debris

Introduction

Woody debris is a major contributor to structural diversity in forests and provides habitat for plants, mammals, amphibians, insects, and micro-organisms. It influences hillslope and stream geomorphology, affects the microtopography and microclimate of the forest floor, is an important nutrient and moisture pool, and in some ecosystems, may be a nitrogen fixation site.

This section outlines the procedures for establishing the sampling transects, for deciding which woody debris to measure, and for recording the measurements.

Objectives

1. To accurately determine the gross volume of Fine (FWD), Small (SWD) and Coarse woody debris (CWD) by decay class.
2. To identify merchantable material and potential removals.

Definitions

Coarse woody debris (CWD), for the purpose of this inventory, is defined as dead woody material located above the soil, in various stages of decomposition. CWD must be larger than 7.5 cm in diameter (or equivalent cross section) at the crossing point, and not self-supporting. Trees and stumps (intact in ground) are considered self supporting.

CWD can also be in the form of felled and bucked logs or log decks.

Small woody debris (SWD), for the purposes of this inventory, is defined as dead woody material located above the litter layer, in various stages of decomposition. Small woody debris must be 1.1 cm or larger and less than 7.6 cm in diameter (or equivalent cross section) at transect crossing point, and not self supporting. Trees and stumps intact in the ground are considered self supporting.

Fine woody debris (FWD), for the purposes of this inventory, is defined as dead woody material located above the litter layer, in various stages of decomposition. Fine woody debris must be less than 1.1 cm in diameter (or equivalent cross section) at the crossing point, and not self supporting. Trees and stumps intact in the ground are considered self supporting.

General Procedures

1. Set out the 30 m sampling transects.
2. Assess the transect conditions.
3. Measure and record information for the woody debris pieces.

Field Cards for this Section

Coarse Woody Debris (EW) (Appendix A, Figure A.8)
Field card for the random transect 1, species, diameter, % class 1, other decay class, tilt angle, accumulations.

Coarse Woody Debris (EC) (Appendix A, Figure A.9)
Field card for transect 2, species, diameter, % class 1, other decay class, tilt angle, accumulations.

National Forest Inventory – Small Woody Debris (Appendix N)
Field card for recording small and fine woody debris in classes by average decay class.

Detailed Procedures

8.1 Establishing the Sampling Transects

Woody debris is sampled along two horizontal 30 m line transects extending from the IPC.

1. Establish the first line at a pre-assigned random azimuth from the IPC.
2. Measure out along the random azimuth with a tape to 30.0 m, correcting the distance to horizontal.
3. Mark 10.0 meters, 20.0 meters and the end of the transect.
4. Mark along the line with logging paint the intersection of the line transect with potential small and coarse woody debris.
5. Number a few of the large CWD with log marking paint to aid remeasurement and quality control.
6. Establish the second line at plus 90° from the first transect commencing at the IPC.
7. Record the azimuth of each line on the Coarse Woody Debris (EW) and (EC) Field Cards.
8. Measure the following pieces of coarse and small woody debris along the transect:
    a. From the IPC to 10.0 metres measure all CWD greater than 30.0 cm.
    b. From 10.0 metres to 20.0 metres measure all CWD equal to or greater than 7.6 cm.
    c. From 20.0 metres to the end of the transect measure all SWD and CWD equal to or greater than 1.1 cm.
9. Record the following measurements for the coarse and small woody debris:
    a. For the CWD record the standard measurements
    b. For the SWD record the following attributes
        (i) Number of pieces by diameter class (the equivalent area for odd shaped pieces is also displayed) as follows:
        - Class 1 = 1.1 cm to 3.0 cm (0.8 cm² to 7.1 cm²)
        - Class 2 = 3.1 cm to 5.0 cm (7.1 cm² to 19.6 cm²)
        - Class 3 = 5.1 cm to 7.5 cm (19.6 cm² to 44.1 cm²)

c. For SWD assign one average decay class for all pieces

Note: The following conditions should be noted when measuring SWD:

a. Small woody debris may include wood chunks, bark and cones

b. Small woody debris should only be measured if it is above the litter (L layer)

c. Odd shaped pieces will be estimated as an equivalent round diameter class. Measurement is made perpendicular to their length

d. Branches, roots etc (less than 7.6 cm) that intersect each transect (these may be attached to CWD) are to be measured

e. If a crown from a fallen tree is encountered, estimate the number of line intersects and record the average diameter for the group rather than individually measuring each intersection.

f. If aerial pieces are encountered only measure the piece if it is located in the B2 shrub layer (0.0 metres to less than 2.0 metres above the ground)

8.2 Assessing the Transect Conditions

Normally, the full length of the transect will be sampled. However unsafe or difficult conditions may be encountered where it may not be possible to sample the full length.

If the full length of the line cannot be sampled, record the distance actually sampled, and explain in the Comments section why the remainder was not measured.

Possible situations are:

1. **Normal conditions** — Sample both 30 m transects using the procedures outlined in Section 8.3.

2. **Anomalous conditions** — If the sample line intercepts an anomaly along the transect such as a stream, pond, avalanche chute, on a rock outcrop (Figure 8.1) continue to sample the line as long as it is safe to do so. If the debris is floating, the pieces are measured in their location at the time of sampling (make a note of this in the comments).

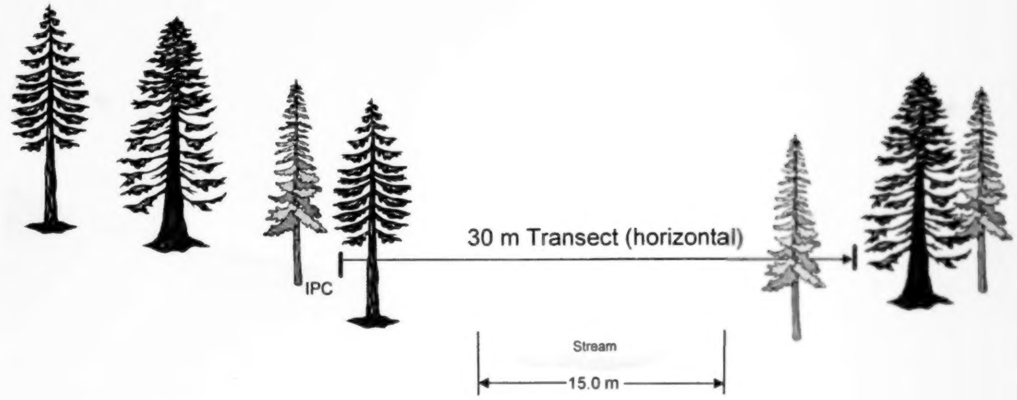


Figure 8.1 — CWD transect encounters an anomaly within the plot.

3. **Unsafe conditions** — If the sample line intercepts unsafe conditions, record the length of the line actually sampled in the field.(for example if you encounter a cliff at metre 19) record "horizontal length observed 19 out of 30". Note in the Comments section why a portion was not sampled.

4. Transect encounters a heavy accumulation of CWD

   The National Forest Inventory will be measuring the full length of all woody debris transects as long as conditions are safe for the crew.

8.3 Sampling CWD Along the Transects

Which CWD to measure

Measure the following along the transects:

- All pieces of CWD greater than 7.5 cm in diameter (44.2 cm^2 perpendicular to the piece length for odd shaped pieces) where the centerline of the piece is crossed by the vertically projected transect.
- Fallen or suspended (not self-supporting) dead tree boles, with or without roots attached, that intercept the vertically projected sample line whether the transect passes above or below the CWD (Figure 8.2). Visually estimate un-measurable suspended CWD at the intercept point.

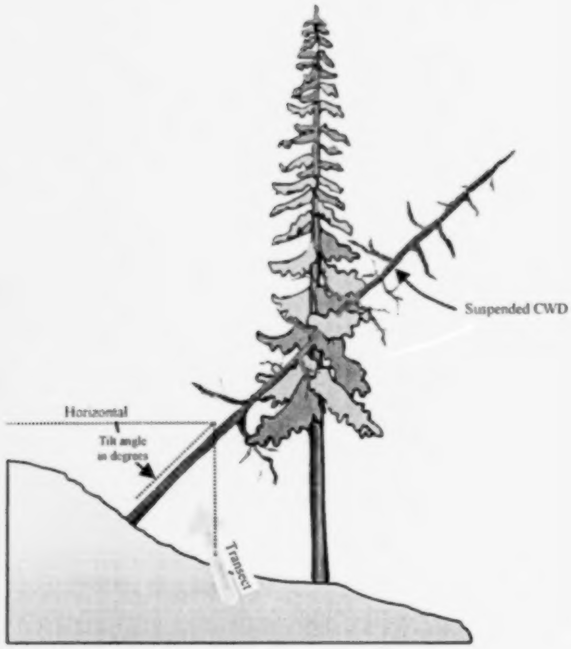


Figure 8.2 — Measuring suspended CWD.

- Fallen trees with green foliage if they are no longer rooted to the ground.
- Large fallen branches and fallen broken tree tops, horizontal or leaning.
- Pieces that are physically attached (lengthwise) are considered to be one piece.
- Recently cut logs.
- Uprooted stumps greater than 7.5 cm in diameter, and any exposed dead roots greater than 7.5 cm.
- CWD that lies above the soil (Figure 8.3). CWD is considered no longer above the soil when it is entirely buried beneath a layer of surface organic matter (forest floor) or mineral soil.

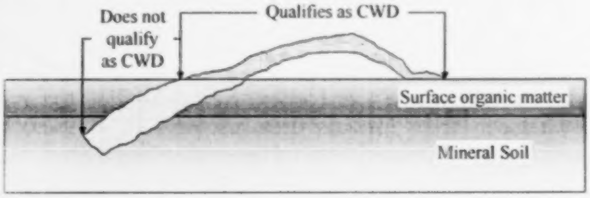


Figure 8.3 — Side view of partially buried coarse woody debris.

Do not measure the following:

- live or dead trees (still rooted) which are self-supporting
- dead branches still connected to standing trees
- exposed roots of self supporting trees

- self-supporting stumps or their exposed roots
- a piece is no longer considered CWD when the wood is decomposed to the point where it could be described as forest floor humus.

Determining "in" or "out" CWD

To be measured the CWD piece must be greater than 7.5 cm in diameter (or equivalent) at the point where the line transect crosses the centreline. The *centreline* is the midline of any section of wood (Figure 8.4 and 8.5.), and may not correspond to the pith.

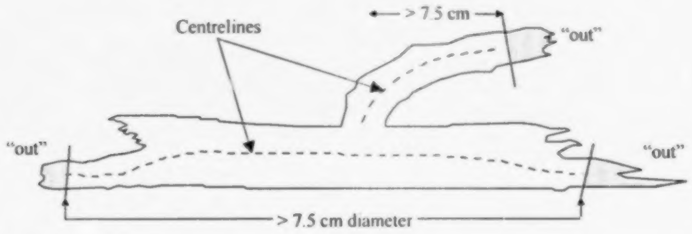
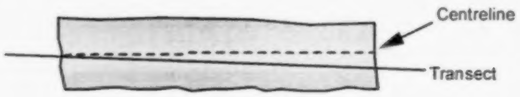


Figure 8.4 — Centreline of a CWD piece (top view).

If the sample line appears to follow the centreline of the CWD, decide whether it is "measured" (transect line crosses centreline of CWD) or "not measured" (transect line does not cross centreline).



If the sample line is close to the centreline at the end of the CWD, decide whether it is "measured" (transect line crosses centreline of CWD) or "not measured" (transect line does not cross centreline).

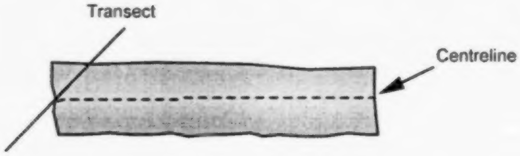


Figure 8.5 — Measuring CWD near the centreline of the piece.

Measuring CWD in the Standard Transect Section

For each CWD record the following:

SPECIES	Record tree species at the level it is reliably known. See Code Table below.
DIAMETER	Record the diameter (to nearest 0.1 cm) perpendicular to the point where the transect crosses the centreline of the CWD. For non-circular pieces, record in the "Accumulation and/or Odd-shaped Pieces" by a different method.
LENGTH	Not required for NFI. Used to note the length of the piece of CWD.
% DECAY CLASS 1	Record the percentage of "Class 1" wood at the transect crossing.
CLASS OTHER	Record the decay class of the **remaining** percentage at the transect crossing.
TILT ANGLE	Measure the tilt angle of the piece, in degrees.
MERCHANTABLE	Note if the piece is merchantable (X grade or better).
P/R	Note if the CWD is a product likely to be removed (P/R).
DECAY CLASS FOR PIECE	Record the decay class of the CWD piece.

SPECIES

1. Record the tree species using the approved tree species code (see Appendix C).

2. If the species or genus cannot be determined, record the best available information as follows:

Zc _	other conifer not on the list (record species name in Comments section)
Xc _	unknown conifer
Zh _	other hardwood not on the list (record species name in Comments section)
Xh _	unknown hardwood
X _ _	unknown (you cannot determine if it was conifer or deciduous)

DIAMETER

1. Record (to nearest 0.1 cm) the diameter (or equivalent) of the CWD perpendicular to the bole at the point where the transect crosses the CWD (Figure 8.6).

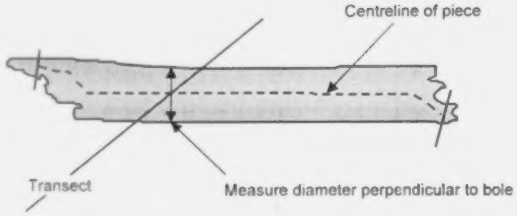


Figure 8.6 — Measuring diameter of circular CWD cross sections.

2. If the sample line intersects a curved or angular CWD more than once, measure each intersection as a separate observation, as shown in Figure 8.7.

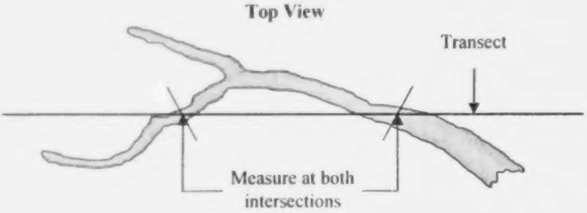


Figure 8.7 — The sample line intersects the CWD more than once.

3. If the diameter cannot be measured, estimate it.

4. If the cross section is oval rather than circular estimate an "equivalent diameter" that will more accurately suggest the cross-section area. If the cross section is hard to express as a circle (or equivalent to a circle), refer to the procedures for measuring odd-shaped CWD.

5. Estimate an "equivalent" diameter for the remaining portion of CWD where part of the wood has decayed and become part of the soil layer.

6. If a log has split open but is still partially held together, record the equivalent diameter as if the piece were whole. If a stem has shattered into a number of distinct unconnected pieces, record each piece that is larger than 7.5 cm in diameter at the point of sampling.

7. If the CWD is hollow, estimate the diameter equivalent to the remaining wood.

LENGTH

For the National Forest Inventory, the measurement of piece length is not required. A field has been left on the field card in case specific projects require length measurements for other purposes.

% Decay Class 1 (at the Transect Crossing)

All CWD cross sections will be assessed a percentage decay class 1. The decay classes are shown in Table 8.1.

- Determine the percentage decay class 1 by probing the CWD close to the point of intersection with an axe (do not destroy the CWD at the line intercept)

- Record the percentage of decay class 1
- If decay class 1 equals 100%, record as "__ __"
- If decay class 1 equals 0%, record as "00"

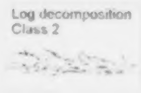
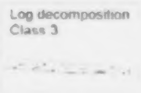
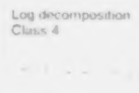
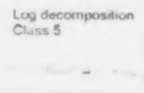
Note: Percentage decay class 1 is an estimate across the cross section, not for the CWD as a whole. Decay class 1 is equivalent to wood commonly referred to as "sound" which is suitable for lumber or chips (regardless of the length or diameter).

CLASS OTHER (AT THE TRANSECT CROSSING)

Record the decay class of the **remaining** percentage of the CWD piece cross section using the classification scheme shown in Table 8.1.

- The emphasis is on the wood texture. Other criteria, such as portion on the ground, twigs, bark, shape, and invading roots, are guidelines to the wood texture.

Table 8.1 — Coarse woody debris decay classes

					
	CLASS 1	**CLASS 2**	**CLASS 3**	**CLASS 4**	**CLASS 5**
WOOD TEXTURE	**intact, hard**	**intact, hard to partly decaying**	**hard, large pieces, partly decaying**	**small, blocky pieces**	**many small pieces, soft portions**
Other associated characteristics					
PORTION ON GROUND	elevated on support points	elevated but sagging slightly	sagging near ground, or broken	all of log on ground, sinking	all of log on ground, partly sunken
TWIGS < 3 cm (if originally present)	twigs present	no twigs	no twigs	no twigs	no twigs
BARK	bark intact	intact or partly missing	trace bark	no bark	no bark
SHAPE	round	round	round	round to oval	oval
INVADING ROOTS	none	none	in sapwood	in heartwood	in heartwood

TILT ANGLE

The tilt angle is the angle, measured in degrees, between the central axis of the CWD and the horizontal plane at the crossing point (Figure 8.8).

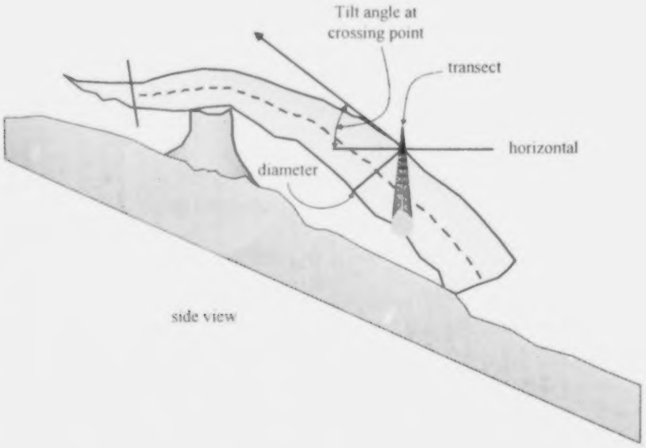


Figure 8.8 — Measuring the tilt angle of CWD pieces.

Measure the angle the CWD makes from the horizontal, regardless of the slope of the ground. Normally you can place a clinometer on the top surface of the CWD at the point of the intercept and record the angle in degrees.

MERCHANTABILITY

If the CWD is an X grade or better, record it appropriately. An X grade or better may potentially be harvested.

PRODUCT TO REMOVE P/R

This procedure is designed to accommodate wood that might be removed from the site. If the piece is expected to be removed as product (for example, blowdown which is scheduled for harvest, shakeblocks or felled and bucked material), record an "X" in the P/R Column. This does not include a merchantable piece that is expected to be left on site.

DECAY CLASS FOR PIECE

Record the class for the entire CWD piece using the classification scheme shown in Table 8.1.

- Decay Class is based on the wood texture. Assess the conditions along the entire piece length to determine Class on the basis of volume. Other criteria, such as the portion on the ground, twigs, bark, shape, and invading roots, are guidelines to the wood texture.

Measuring Odd-Shaped CWD

Record any odd-shaped CWD encountered in the appropriate section of the field card.

Note: It is important that any CWD that is not round or oval in cross section be recorded in this category. A different volume compilation formula is used because the measurement is made along the transect line, **not** at right angles to the centreline of the CWD.

---

1. Record the species of the CWD.
2. Measure the full horizontal length and average vertical depth of the CWD along the transect (this gives a rectangular area equivalent to the cross section along the transect).
   - the length is the full distance along the line intersect (shown as "L" in Figure 8.9).
   - the depth of the cross section is the average depth along the line intersect (shown as "D" in Figure 8.9).

Note: It is incorrect to measure the length and width, average the values, and record it as a circular cross section.

Example: An odd-shaped CWD is 25 cm x 40 cm.

Consider the cross section as a rectangle and record the 25 and 40 in the accumulations section.

Record the other information in the same way as in the "standard transect" section for round pieces.

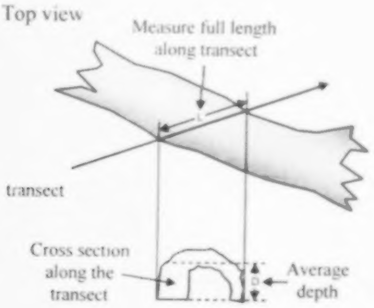

Top view
Measure full length along transect
L
transect
Cross section along the transect
D
Average depth

Figure 8.9 — Measuring the horizontal length and vertical depth of odd-shaped CWD.

Measuring Accumulations

In heavy accumulations that cannot be safely or accurately measured, record an estimate of the depth and length of the accumulation.

1. Record the **full** horizontal length of the line intercept through the accumulation, and the **average** vertical depth of the accumulation. Visually compress the pile to measure the actual cross sectional area of wood, not the space between the pieces, as shown in Figure 8.10.
2. Identify and record species, as possible.

If the mixture of species is complex or too difficult to identify, record the following:

Zc _	other conifer not on the list (record species name in Comments section)
Xc _	unknown conifer
Zh _	other hardwood not on the list (record species name in Comments section)
Xh _	unknown hardwood
X _ _	unknown (you cannot determine if it was conifer or deciduous)

3. If species can be determined, estimate the proportion of each, and record length and depth for each species separately.

Note: This horizontal and vertical cross section is the part which is *along the transect line*, not the average of the entire pile, and CWD described in this way is treated as rectangular in cross section.

---

4. For each species, record the other information in the same way as in the standard transect section.

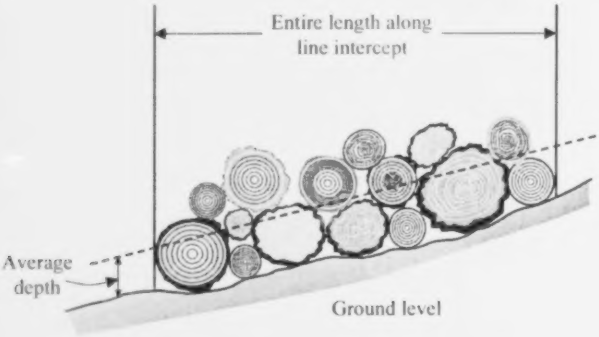


Figure 8.10 — Measuring an accumulation of coarse woody debris.

8.4 Sampling FWD on the Micro-plots

1. Establish the range micro plots at 6.0m and 12.0m along the line transects
2. Collect all fine woody debris less than 1.1cm in diameter within each of the micro plots which is above the litter layer
   (a) Clip pieces less than 1.1cm at the plot edge. Collect all pieces less than 1.0cm in diameter within the micro plot.
   (b) If a piece within the micro plot is less than 1.1cm at one end of the piece and greater than 1.1cm at the other end clip the piece at 1.1 cm diameter and collect the portion less than 1.1 centimeters. For example, if a large woody debris piece

located in the micro plot has fine branches less than 1.0cm these would be clipped at the tree bole or at 1.1cm and collected.

(c) Pieces which extend into the litter layer will be clipped at the surface of the litter layer.

(d) Collect all pieces within one bag for all 4 micro plots for subsequent removal from the site and further measurement. Pieces may be cut into convenient sized portions to facilitate bagging the material.

(e) Cones, bark, wood chunks and other debris less than 1.1cm will also be collected

(f) If aerial pieces are encountered only collect pieces located in the B2 shrub layer (0.0m to less than 2.0m above ground level)

(g) Store the collected material in a cool dry place in a well ventilated bag to inhibit development of mould or fungal growth

(h) Place a label in each bag identifying the sample number and whether there is more than 1 bag for a sample (identify as 1 of 1, or 2 of 3, etc.]

(i) The fine woody debris will, if necessary, be air dried to remove excessive moisture. The sample will then be oven dried (55 degrees for 24 hours) and weighed with the information recorded on the CFS field card.

Note: a detailed field sheet to collect the fine and small woody debris data has been developed by the CFS and is attached in Appendix N.

---

9. Range Resources

Introduction

Livestock and wildlife species use shrub and herbaceous biomass at various times of the year, and depend on the availability of these plants for their health and survival.

To manage livestock, range managers also need estimates of forage production and utilization of graminoids and forbs. This information may be used to allocate forage to livestock and wildlife in selected areas, to create short- and long-term plans, to make decisions on range improvements, to determine seral stages of plant communities, and to measure changes in plant community composition over time. Species composition and identification of site series is described in Section 7.

Forage production estimates may be correlated with other vegetation (such as forest or terrestrial) cover attributes and then projected across the growing season for site series or other vegetation classes.

Forage utilization information is used to adjust production estimates to reflect total forage abundance prior to grazing by wildlife or livestock. These estimates may also be used to determine use zones and may also contribute towards range-use planning (along with other range samples). Forage measurements in the National Forest Inventory (NFI) procedures can be made at any time during the growing season, therefore range managers may choose to use these estimates only as an indication of total production or utilization for that location.

Range managers require information on the species composition of livestock forage and identification of site series. The method for generating a comprehensive vegetation list for identifying site series is described in Section 7: Plants, Soils and Old Growth.

Objectives

1. To provide estimates of forage production of graminoids and forbs by clipping plots.
2. To provide estimates of forage utilization of graminoids and forbs using forage utilization classes.

Definitions

Where indicated, definitions are from *A Glossary of Terms Used in Range Management*, Society for Range Management (S.R.M.) 1989.

Foliar Cover is defined as the percentage of ground covered by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded. Foliar cover is always less than canopy cover; either may exceed 100% (S.R.M.).

Forage Production is the weight of forage that is produced within a designated period of time on a given area. The weight may be expressed as either green, air-dry, or oven-dry. The term may also be modified as to time of production such as annual, current year's, or seasonal forage production (S.R.M.). Production can also be expressed as animal unit months (AUMs), which is the amount of dry forage required by one animal unit for one month based on a forage allowance of 26 pounds (11.7 kg) per day.

Forbs are any broad-leafed herbaceous plants except Gramineae (or Poaceae), Cyperaceae and Juncaceae families (S.R.M.) and, for forage measurement purposes, include ferns and fern allies, club mosses, and horsetails.

Graminoids are grass or grass-like plants (sedges and rushes) such as *Poa*, *Carex*, and *Juncus* species (S.R.M.).

Phenology is the study of periodic biological phenomena which are recurrent, such as flowering or seeding, especially as related to climate (S.R.M.).

A shrub is defined as a plant that has persistent woody stems and a relatively low growth habit and that generally produces several basal shoots instead of a bole. It differs from a tree by its low stature (generally less than 10 m) and non-treelike form (*Glossary of Range Terms*, Ministry of Forests 1994). Appendix K Low woody species and intermediate life forms lists doubtful lifeform species that are, for the purpose of this inventory, to be considered forbs and not shrubs. Therefore they are to be included in the clipped plot and nct in the line intercept.

Stolon is a horizontal stem which grows along the surface of the soil and roots at the nodes (S.R.M.). A stoloniferous plant is a plant that has stolons.

Utilization is the proportion of current year's forage production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole (S.R.M.).

Utilization refers to the percentage of plant weight removed, not the percentage of plant height removed.

General Procedures

Forage production measurements are discussed in this section. The recommended sequence of procedures is shown below:

1. On the transect line established for the measurement of woody debris, establish the forage sampling micro-plots.
2. Estimate and record forage use.
3. Clip the forbs and graminoids to measure forage abundance.

Field Cards for this Section

Range Sampling (RS) (Appendix A, Figure A.7)
forage production section only (it should be noted that the existing field cards indicate the collection of information that is additional to the data collection requirements for this program.)

Detailed Procedures

9.1 Establishing Forage Sampling Micro-Plots

Forage production measurements are usually made immediately after the Integrated Plot Centre (IPC) is established to avoid trampling of the forbs and graminoids.

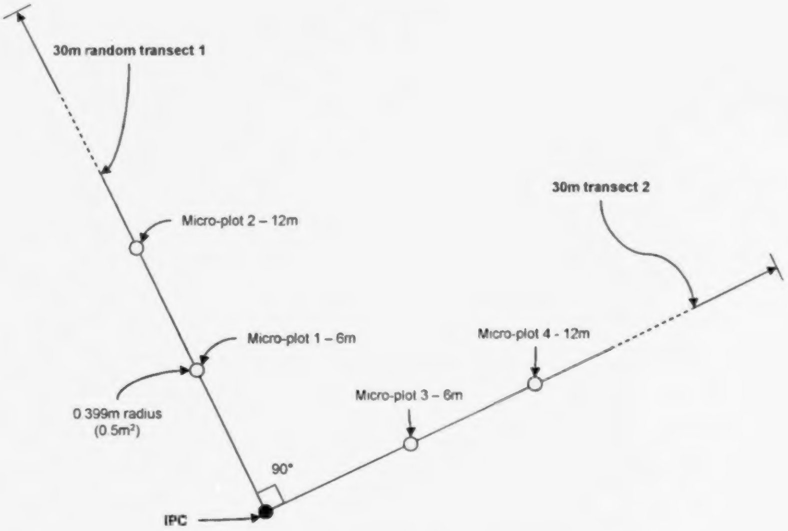


Figure 9.1 — Range resources sampling transects and micro-plots.

Procedure

1. Using the coarse woody debris transects, establish four micro-plots at points 6 m and 12 m (horizontally corrected distance) from the IPC. Each micro-plot has a radius of 0.399 m and an area of 0.5 m^2.
2. The design of the transects and micro-plots is shown in Figure 9.1.

9.2 Estimating Forage Utilization

Procedure

1. Examine the herbaceous plant use within each of the four micro-plots and the area immediately adjacent (1 — 2 m around) and estimate forage use. Refer to Table 9.1 for a description of utilization classes and codes. You may find the utilization gauge developed by the USFS Rocky Mountain Forest and Range Station useful for some British Columbia species.
2. Record the utilization code on the field card before clipping herbaceous plants as described in Section 9.3.

Table 9.1 — Herbaceous forage utilization classes and codes

Code	Class	Range (% utilized)	Utilization
0	Nil	(0%)	The plants show no evidence of use.
1	Slight	(1 to 15%)	The plants show very little evidence of use and have the appearance of very slight grazing. Key forage plants may be topped or slightly used. Current seed stalks and young plants of key species show little disturbance.
2	Light	(16 to 35%)	The plants may be topped, skimmed, or grazed in patches. Low-value plants are ungrazed and 60 to 80% of current leafage of key plants remain intact.
3	Moderate	(36 to 65%)	The plants appear rather uniformly grazed. Fifteen to 25% of the number of current leafage of key species remain intact. No more than 10% of the number of low-value forage plants are used. (Moderate use does not imply proper use). Applied to a use zone, the area is entirely covered as uniformly as natural features or livestock facilities will allow.
4	Heavy	(66 to 80%)	Key species are almost entirely used, with <10% of the current leafage remaining. More than 30% of the number of low-value plants have been utilized. Applied to a use zone, the area has the appearance of complete search. Some trampling damage may be evident.
5	Extreme	(>80%)	Key species that are carrying the grazing load and are closely cropped. There is no evidence of reproduction or current seed stalks of key species. Applied to a use zone, the area has a mown appearance, and there are indications of repeated coverage. Trampling and trailing is evident.
From *Procedures for Environmental Monitoring in Range and Wildlife Habitat Management*, Habitat Monitoring Committee 1990			

9.3 Clipping the Plot

Procedure

1. All plots will be fully clipped. Record an "X" in the "full" box on the field card.
2. Collect and label the current year's growth of herbaceous material. Clip all the live material (at a height of 2 cm) of the forbs and graminoids in each of the four micro-plots. The material will be oven-dried in a drying oven at 55° C for 24 hours, and weighed in the field office. This measurement is used as an indicator of forage production.
3. Clip all forb and graminoid species as listed in the B.C. Ministry of Forests Vegetation Coding List.
    - Clip a forb or graminoid if the germination point is within the plot.
    - A plant is considered "in" or "out" of the plot depending on the germination point where the plant enters the soil.

- A stolon from a stoloniferous plant (such as wild strawberry) rooted within the plot is considered part of the plot. (Clip the stolon at the plot boundary if the stolon is rooted outside the plot perimeter.)
- A non-rooted stolon connected to a stolon rooted within the plot is considered part of the plot.
- If a plot splits a large clump of grass (where the germination point is not easily determined) then clip the portion within the plot.
- If the base of the forage is in standing water, clip the material below water line at the 2 cm height if practical. If not practical, clip the material at the water line and record an estimate of the portion clipped in the comments.
- Clip doubtful forb species listed in Appendix K — Low woody species and intermediate life forms.
- Do not spend excessive time separating live current year's growth from dead vegetation. If a small amount of dead forbs or graminoids are present, simply remove a corresponding amount of live material. This will save time and still give a reasonable estimate of forage production.

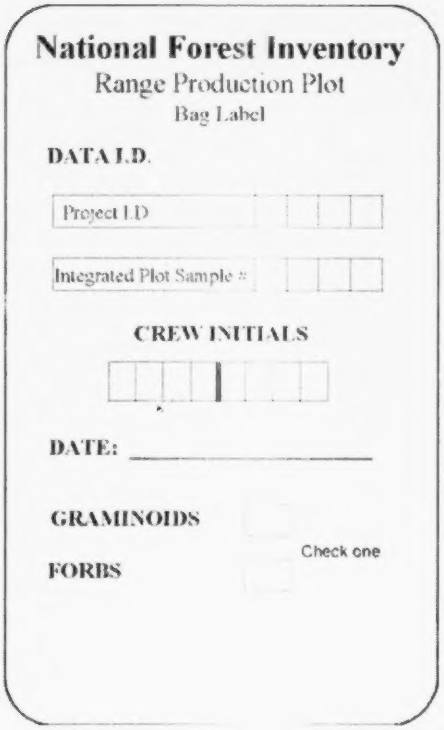
4. Record (Y/N) on the RS Field Card (Appendix A, Figure A.7) if the forbs or graminoids have been collected.

5. Place the clipped samples in collection bags. Keep the forbs and graminoids in separate bags. Group all the forbs for a sample (4 micro-plots) in one bag and all graminoids for a sample in a separate bag.

6. Complete the sample labels (Figure 9.2) and return the bags to the field office where they will be oven dried (55°C for 24 hours) and weighed, and the information recorded on the RS field card. It is appropriate to air dry the sample before oven-drying. To air-dry, leave the forage in paper bags open in a warm dry room for several days as necessary to remove excess moisture. Rotate the forage in the bags to ensure even drying and to prevent decomposition.

Appendix K provides a list of low woody species and species of doubtful lifeform assigned to the herb (C) layer. These plants are collected as forbs in the forage production plots. A complete species list is available for downloading in Access97 database format or as an Excel file from the following locations via the RISC or Ministry of Forests websites at: http://www.for.gov.bc.ca/research/becweb/standards-species.htm

The species of doubtful lifeform are listed as "lifeform 12" on these files.



National Forest Inventory

Range Production Plot

Bag Label

DATA I.D.

Project I.D	☐☐☐
Integrated Plot Sample #	☐☐☐

CREW INITIALS

☐☐☐☐☐☐☐

DATE: ____________________

GRAMINOIDS ☐

FORBS ☐

Check one

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Index

- Age
  - bored ages, 62
  - direct measurement of age correction, 63
  - direct measurement of small tree ages, 63
  - physiological, 64
  - radial increments, 64
  - whorls, 68
- Aspect, assessing site features, 140
- Bark
  - remaining, 38
- Bark retention, 44
- Biogeoclimatic unit, 135
- Blind conk
  - deduction rule, 76
  - loss indicator, 51
- Broken tops, 42, 54
  - deduction rule, 87
- Butt rot
  - call grading, 94
- Call grading
  - cedar grading criteria, 103
  - cedar shingle, 98
  - conventions, 93
  - criteria tables, 98
  - cypress, yew grading criteria, 117
  - deciduous grading criteria, 121
  - definition, 91
  - fir, pine, larch grading criteria, 98
  - frost cracks, 95
  - guidelines, 93
  - hemlock/balsam grading criteria, 109
  - Occasional Larger Knots (OLG), 95
  - procedures, 92
  - small trees, 93
  - snags, 93
  - spruce grading criteria, 113
  - sun checks, 95
  - twist, 96
- Call grading criteria
  - cedar, 103
  - cypress, yew, 117
  - deciduous, 121
  - fir, pine, larch, 98
  - hemlock/balsam, 109
  - spruce, 113
- Canopy gaps, 173
- Cat face
  - deduction rule, 81
- Cedar shingle
  - call grading, 98
- Clipping
  - forage, 199
- Cluster Layout card (CL), completing, 31
- Coarse fragments, soil, 150
- Coarse woody debris
  - accumulations, 191
  - assessing conditions, 183
  - decay classes, 189
  - definition, 181
  - diameter, 187
  - heavy accumulation, 184
  - in or out, 186
  - Merchantability, 190
  - odd-shaped pieces, 191
  - partially buried, 185
  - percentage sound wood, 188
  - procedures, 182
  - sampling, 184
  - species, 187
  - suspended, 185
  - tilt angle, 189
  - transects, 21
  - transects, 182
- Code table
  - bark retention, 44
  - crown class, 41
  - crown condition, 44
  - loss indicators, 49
  - remaining bark, 38
  - tree status, 37
  - user species, 47
  - wildlife use, 45
  - wood condition, 44
- code tables
  - tree size, 176

Code tables
  canopy gaps.....174
  CWD decay classes.....189
  CWD species codes.....187
  forage utilization.....199
  humus form.....147
  meso slope.....141
  microtopography.....142
  old growth forest.....178
  plot uniformity.....135
  rocky substrate.....142
  site disturbance.....169
  snags / CWD.....173
  snags > 25 cm.....173
  soil colour.....148
  soil features.....146
  soil horizon.....148
  Soil Moisture Regime.....136
  Soil Nutrient Regime.....137
  stand age.....176
  structural stages.....176
  successional stability.....175
  surficial material.....145
  tree harvesting.....172
  unknown plant species.....159
  vegetation layers.....166
  vertical structure.....174

Compass Card (CP), completing.....30

Conk, heart rot.....74

Conversion tables
  percent coverage to horizontal area..166

Coverage to horizontal area.....166

Crook.....53
  deduction rule.....85

Crown
  height to live.....41

crown class.....41

Crown condition.....43

CWD.......... 181, See coarse woody debris

Damage agents
  assessing.....47

Dead top.....54
  deduction rule.....86

Deduction rules.....74
  blind conk.....76
  broken (missing) top.....87
  butt rot.....84
  cat face.....81
  crook.....85
  dead top.....86
  direct observation.....88
  fork.....85
  frost crack.....77
  heart rot conk.....74
  multiple defects.....89
  other types.....89
  root rot.....75
  rotten branch.....86
  scar.....78
  summary.....74

Depth to, soil features.....146

Depth, soil.....149

Diameter Breast Height (DBH).....37

Ecological data plots.....20

Ecological plots
  establishing.....133

Ecological sampling.....131

Ecological variability
  assessing.....133

Elevation (m), assessing site features.. 140

Field cards
  Cluster Layout (CL).....6, 18
  Compass Card (CP).....6, 10, 18
  completing Cluster Layout (CL).....31
  completing Compass Card (CP).....30
  completing Header Card (CH).....27
  completing Site Tree Card (TS).....65
  Header Card (CH).....6, 18
  Small Tree, Stump, and Site Tree Data (TS).....34
  Tree Details (TD).....34, 91
  Tree Loss Indicators (TL).....34, 92

Flood hazard indicators.....144

Flood hazard, assessing site features... 143

Foliar cover
  definition.....196

Forage
  clipping.....199
  micro-plots.....197

  production definition 196
  utilization codes 199
  utilization definition 196
  utilization estimating 198

Forbs
  definition 196

Fork 53
  deduction rule 85

Frost crack
  deduction rule 77
  loss indicator....................................... 52

Frost cracks
  call grading 95

Gaps
  canopy 173

GPS Requirements 15
  Minimum Settings 15

Graminoids
  definition 196

Ground photographs 23

ground sampling
  principles 1

Gullies, assessing site features 143

Header Card (CH), completing.............. 27

Heart rot
  call grading 93

Heart rot conk
  deduction rule 74

Height to live crown 41

Humus form... 147

In and out
  stumps.. 57

Inaccessible sample 14

Insect damage 95

Integrated Plot Centre............................ 16
  establishing 13
  photos 24
  pin 13

Inventory cruising 33

Land cover classification 137

Large rotten branches.............................. 53

Leading species tree 20

Leading species trees
  recording 65

lichen loading... 45

Log grades summary
  cedar.. 124
  coniferous.. 128
  cypress, yew 127
  deciduous 129
  fir, pine, larch.................................... 123
  hemlock/balsam 125
  spruce 126

Log lengths, minimum 92

Loss indicators
  blind conks 51
  broken top 54
  crook 53
  dead top 54
  direct observation................................ 55
  fork 53
  frost crack.. 52
  large rotten branches 53
  other 55
  root disease.. 50
  scar 52
  sounding 54
  stem decay 50

Meso slope, assessing site features 140

Microtopography, assessing site features
.... 142

Multiple defects
  deduction rule 89

Net factoring
  definition 71
  procedures 72

Occasional Larger Knots (OLK)
  call grading 95

Old growth forest 178

Old live trees remaining 178

Open water, assessing site features 144

Pencil bucking
  definition 71

Phenology
  definition 196

Photographs .... *See* ground-photographs

Physiological age
  measuring 64

Pins
  integrated plot 13
  reference pin 13

Plant species identification 161

Plants, Soils, and Old Growth 131

Radial increments
  measuring 64

Random trees
  recording 65

Range .... *See* forage

Range resources 195

Reference Point
  establishing 12
  navigating to 11

Remaining bark percentage 38

Rocky substrate, assessing site features 142

Root disease
  loss indicator 50

Root rot
  deduction rule 75

Rotten branches
  deduction rule 86

sampling plots
  small tree and stump plot 19

Sampling plots
  coarse woody debris transects 21
  ecological 133
  ecological plots 20
  forage micro-plots 197
  Integrated Sample Plots 18
  range forage production plots 22
  top height tree plot 19
  tree detail plot 18

Scar
  deduction rule 78
  loss indicator 52

Second site tree 20

Shrub
  definition 196

Shrubs
  estimating height 167

Site classification 135

Site disturbance 168

Site disturbance indicators 171

Site features 140

Site series and coverage 136

Slope failure, assessing site features.... 142

Slope instability indicators 143

Slope, assessing site features 140

Small tree and stump plot 19

Small trees
  call grading 93
  tallying 56

SMR 136

Snags
  call grading 93
  code table 173

Snags/CWD 173

SNR 137

soil features
  depth to 146

Soil features
  coarse fragments 150
  colour 148
  depth 149
  description 148
  horizon 148
  humus form 147
  texture 150

Soil, assessing site features.................. 144

Sounding.. 54

Sounding for decay.................................. 88

Species
  coding plants.................................... 162
  coding system.................................. 158
  collecting unknown 160
  identifying plants............................ 161

Stand structure features 172

Stem decay
  loss indicator..................................... 50

Stem mapping... 55

Stolon
  definition 196

Stratification 175

Structural stages 176

Stumps
  tallying... 57

Succession
  interpreting 168
  tree species....................................... 172

Successional stability 175

Sun checks
  call grading.. 95

Surface Clear 98

Surface shape, assessing site features.. 140

Surficial material, assessing site features
.... 145

texture, soil 150

Tie Point
  establishing 7

Top height tree plot 19

Top height trees
  recording... 65

Transect
  photo.. 23

Tree
  leading species.................................... 20
  second site 20

Tree age, for site series 175

Tree attributes
  assessing for wildlife.......................... 43
  identifying and recording................... 34

Tree detail 18

Tree harvesting 172
  code table 172

Tree loss indicators
  assessing... 49

Tree size, for species and site 176

Tree,Tie Point 7

trees
  crown class codes............................... 41

Trees
  borderline... 34
  broken tops... 42
  crown condition codes 43
  DBH 37
  in and out 34
  length 40
  live old remaining 178
  number 34
  old growth 178
  small trees 56
  species 36
  Status... 37
  status codes 37
  visual appearance codes..................... 43
  wildlife.. 43

Twist
  call grading 96

Uniformity 135

Uniformity, ecological 133

Unknown species 160

User species codes 47

Variability
  assessing ecological 133

Variable length
  definition.. 91

Vegetation layers
  percent coverage 162

Vertical Structure 174
Visual appearance 43
Volume
  calculating 73
Voucher specimens 160
Wildlife trees 43
Wildlife use 45
Wood condition 44

National Forest Inventory – British Columbia

Change Monitoring Procedures for Provincial and National Reporting - Appendix

Prepared by
Ministry of Sustainable Resource Management
Resource Information Branch
for the Resources Information Standards Committee

March 31, 2005

Version 1.4

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Published by the
Resources Information Standards Committee

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Acknowledgments

The Government of British Columbia provides funding of the Resources Information Standards Committee work, including the preparation of this document. The Resources Information Standards Committee supports the effective, timely and integrated use of land and resource information for planning and decision making by developing and delivering focused, cost-effective, common provincial standards and procedures for information collection, management and analysis. Representatives to the Committee and its Task Forces are drawn from the ministries and agencies of the Canadian and the British Columbia governments, including academic, industry and First Nations involvement.

The Resources Information Standards Committee evolved from the Resources Inventory Committee which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII) and by Forest Renewal BC (FRBC), and addressed concerns of the 1991 Forest Resources Commission.

For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

Terrestrial Ecosystem Task Force

The Vegetation Inventory Working Group was formed in 1993 and issued their final report in March 1995 on a "Proposed New Inventory" for British Columbia. The Ministry of Forests, Resources Inventory Branch, in cooperation with the Ministry of Environment and other Ministry of Forests branches and consultants, developed the suite of Vegetation Resources Inventory Procedures based on the recommendations in that report. Many individuals were involved in writing the original version of the various Vegetation Resources Inventory Procedures documents.

The data requirements for the National Forest Inventory closely parallel the attributes collected in the British Columbia Vegetation Resources Inventory (VRI) ground sampling program. The foundations for the procedures in this document are derived from the VRI program.

For questions concerning the content of this publication please contact the:

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Table of Contents

Acknowledgments iii

Appendix A: Completing the Field Cards 207

Appendix B: Ground Sampling Field Guides 231

Appendix C: The Change Monitoring Inventory Tree Code List 255

Appendix D: Damage Agent Codes 261

Appendix E: Damage Severity and Mortality Condition Codes and Standards 267

Appendix F: Calculating Plot Slope Allowances 269

Appendix G: B.C. Land Cover Classification 271

- Introduction 271
  - Who will use the information? 272
- Classifying Land Cover 272
  - Polygon Attribute - The Information Source for the Cover Designation 272
  - The Coding System 273
- Level 1 - Classifying the Land Base 276
- Classifying Vegetated Polygons 276
  - Level 2 - Land Cover Type 276
  - Level 3 - Landscape Position 277
  - Level 4 - Vegetation Type 277
  - Level 5 - Density Class 279
- Classifying Non-Vegetated Polygons 280
  - Level 2 - Land Cover Type 280
- Classifying Non-Vegetated Land Polygons 280
  - Level 3 - Landscape Position (Land) 280
  - Level 4 - Non-Vegetated Cover Type (Land) 281

    Level 5 - Non-Vegetated Categories (Land) 281

  Classifying Non-Vegetated Water Polygons 283

    Level 3 - Landscape Position (Water) 283

    Level 4 - No Level 4 for Water 284

    Level 5 - Water Categories 284

  Literature Cited 284

Appendix H: Latitude and Longitude for Selected Points in B.C. and Declination Values .. 287

Appendix I: Modifications to Ground Sample Marking Procedures as required by Land Custodian 291

  Introduction: 291

  Modifications to marking procedures: 291

  Suggested methods for re-locating the IPC for audit and re-measurement 292

Appendix J: Calculation of Basal Area 295

Appendix K: Low Woody Species and Intermediate Life Forms 297

Appendix L: The Handling, Storage and Shipment of Tree Age Cores 301

Appendix M: Field Equipment and Field Cards for Surface Substrate, Forest Floor and Soil Bulk Density Sampling 303

Appendix N: Field Card for the Collection of Small and Fine Woody Debris Data 309

Glossary 311

Index 319

List of Figures

Figure A.1 — Sample field card 1: Header Card (CH) (front) 208
Figure A.2 — Sample field card 1: Header Card (CH) (reverse) 209
Figure A.3 — Sample field card 2: Compass Card (front) (CP) 210
Figure A.4 — Sample field card 2: Compass Card (CP) (reverse) 211
Figure A.5 — Sample field card 3: Cluster Layout (CL) (front) 212
Figure A.6 — Sample field card 3: Cluster Layout (CL) (reverse) 213
Figure A.7 — Sample field card 4: Range Sampling (RS) (shrub transect 1) 214
Figure A.8 — Sample field card 6: Coarse Woody Debris (EW) (Transect 1) 215
Figure A.9 — Sample field card 7: Coarse Woody Debris (EC) (Transect 2) 216
Figure A.10 — Sample field card 8: Tree Details (TD) (front) 217
Figure A.11 — Sample field card 8: Tree Details (TD) (reverse) 218
Figure A.12 — Sample field card 9: Tree Loss Indicators (TL) 219
Figure A.13 — Sample field card 10: Small Tree, Stump, and Site Tree Data (TS) 220
Figure A.14 — Sample field card 12: Ecological Description 1 (EP) (front) 221
Figure A.15 — Sample field card 12: Ecological Description 1 (EP) (reverse) 222
Figure A.16 — Sample field card 13: Ecological Description 2 (ED) (front) 223
Figure A.17 — Sample field card 13: Ecological Description 2 (ED) (reverse) 224
Figure A.18 — Sample field card 14: Tree and Shrub Layers (ET) (front) 225
Figure A.19 — Sample field card 14: Tree and Shrub Layers (ET) (reverse) 226
Figure A.20 — Sample field card 15: Herb and Moss Layers (EH) (front) 227
Figure A.21 — Sample field card 15: Herb and Moss Layers (EH) (reverse) 228
Figure A.22 — Sample field card 16: Succession Interpretations (EO) (front). 229
Figure A.23 — Sample field card 16: Succession Interpretations (EO) (reverse). 230
Figure B.1 — Field Guide T-1 Net Factor Procedures for Loss Indicators. 233

Figure B.2 — Field Guide T-2 Log Grade Summaries for Fir/Pine/Larch, Common, Small Tree, and Deciduous. 234

Figure B.3 — Field Guide T-3 Log Grade Summaries for Cedar and Hemlock/Balsam, Crown Class Codes, Partial Plot Rules. 235

Figure B.4 — Field Guide T-4 Log Grade Summaries for Spruce and Cypress/Yew, Loss Indicator Codes, Age Measure Codes, and Tree Class. 236

Figure B.5 — Field Guide T-5 Tree Species Codes. 237

Figure B.6 — Field Guide T-6 Wildlife Tree Attributes (crown condition, bark retention, wood condition, visual appearance, wildlife use), CWD decay classes and Accumulation codes. 238

Figure B.7 — Field Guide T-7 Forest Health: Damage Agent Codes. 239

Figure B.8 — Field Guide T-8 Forest Health: Damage Agent Codes - Continued. 240

Figure B 9 — Field Guide T-11 Damage Agent Severity Codes, plus Plot Radius Factors to Tree Face 241

Figure G.1 - Structure of the B.C. Land Cover Classification Scheme - Vegetated polygons 274

Figure G.2 - Structure of the B.C. Land Cover Classification Scheme - Non-Vegetated polygons 275

List of Tables

Table J1: Field Calculation of Basal Area by Species (live trees only) - Field Dot Tally 295

Table J2: Field Calculation of Basal Area per Hectare by Species for NFI plots only 296

Appendix A: Completing the Field Cards

This appendix contains the following sample field cards:

Figure A.1 — Sample field card 1: Header Card (CH) (front)

Figure A.2 — Sample field card 1: Header Card (CH) (reverse)

Figure A.3 — Sample field card 2: Compass Card (CP) (front)

Figure A.4 — Sample field card 2: Compass Card (CP) (reverse)

Figure A.5 — Sample field card 3: Cluster Layout (CL) (front)

Figure A.6 — Sample field card 3: Cluster Layout (CL) (reverse)

Figure A.7 — Sample field card 4: Range Sampling (RS) (shrub transect 1)

Figure A.8 — Sample field card 6: Coarse Woody Debris (EW) (Transect 1)

Figure A.9 — Sample field card 7: Coarse Woody Debris (EC) (Transect 2)

Figure A.10 — Sample field card 8: Tree Details (TD) (front)

Figure A.11 — Sample field card 8: Tree Details (TD) (reverse)

Figure A.12 — Sample field card 9: Tree Loss Indicators (TL)

Figure A.13 — Sample field card 10: Small Tree, Stump, and Site Tree Data (TS)

Figure A.14 — Sample field card 12: Ecological Description 1 (EP) (front)

Figure A.15 — Sample field card 12: Ecological Description 1 (EP) (reverse)

Figure A.16 — Sample field card 13: Ecological Description 2 (ED) (front)

Figure A.17 — Sample field card 13: Ecological Description 2 (ED) (reverse)

Figure A.18 — Sample field card 14: Tree and Shrub Layers (ET) (front)

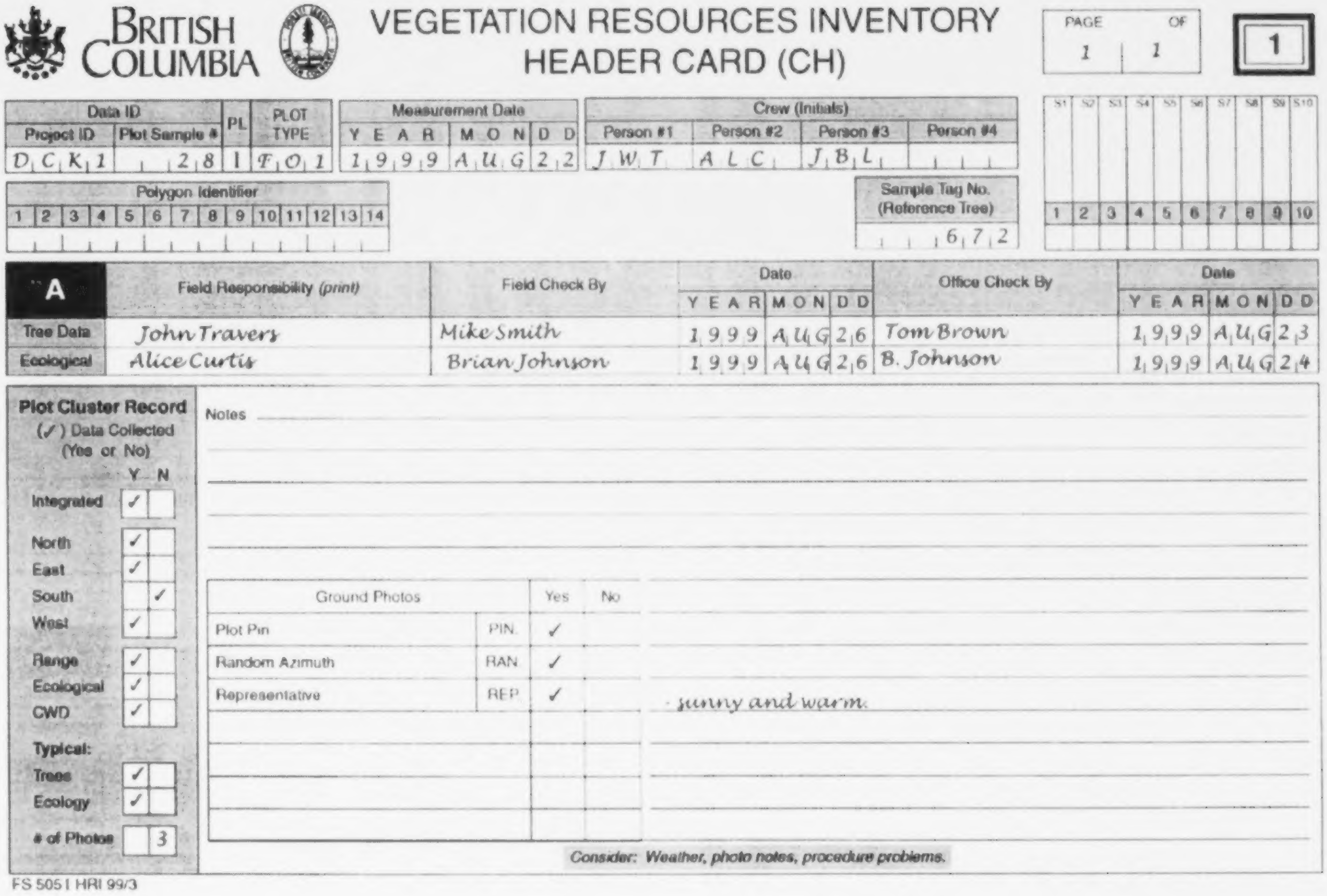
Figure A.19 — Sample field card 14: Tree and Shrub Layers (ET) (reverse)

Figure A.20 — Sample field card 15: Herb and Moss Layers (EH) (front)

Figure A.21 — Sample field card 15: Herb and Moss Layers (EH) (reverse)

Figure A.22 — Sample field card 16: Succession Interpretations (EO) (front)

Figure A.23 — Sample field card 16: Succession Interpretations (EO) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
HEADER CARD (CH)

PAGE 1 OF 1

1

Data ID		PL	PLOT TYPE	Measurement Date			Crew (Initials)			
Project ID	Plot Sample #			YEAR	MON	DD	Person #1	Person #2	Person #3	Person #4
DCK1	28	1	FO1	1999	AUG	22	JWT	ALC	JBL	

S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	2	3	4	5	6	7	8	9	10

Polygon Identifier													
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Sample Tag No. (Reference Tree): 672

A	Field Responsibility *(print)*	Field Check By	Date			Office Check By	Date		
			YEAR	MON	DD		YEAR	MON	DD
Tree Data	John Travers	Mike Smith	1999	AUG	26	Tom Brown	1999	AUG	23
Ecological	Alice Curtis	Brian Johnson	1999	AUG	26	B. Johnson	1999	AUG	24

Plot Cluster Record
(✓) Data Collected
(Yes or No)

	Y	N
Integrated	✓	
North	✓	
East	✓	
South		✓
West	✓	
Range	✓	
Ecological	✓	
CWD	✓	
Typical:		
Trees	✓	
Ecology	✓	
# of Photos		3

Notes

Ground Photos		Yes	No
Plot Pin	PIN	✓	
Random Azimuth	RAN	✓	
Representative	REP	✓	

- sunny and warm.

Consider: Weather, photo notes, procedure problems.

FS 5051 HRI 99/3

Figure A.1 — Sample field card 1: Header Card (CH) (front)

CARD CH

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Access Notes (For Example, Start Junction Hwy. 3 & 97, South 2.7 km on Hwy. 3, Turn Right, 10.6 km on East Main Road then Turn Left, etc.

Commence at junction of Chilliwack River Bridge on Vedder Road.

- east on Chilliwack River road for 26.5 km to second crossing over Chilliwack River.
- thence 1.7 km on same road to junction of logging spur road & Chilliwack main road.
- Junction of roads is tie point.

DIAGRAM / NOTES

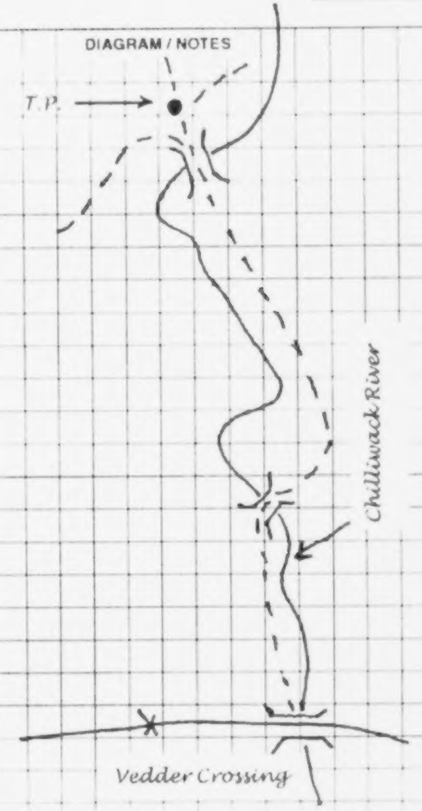
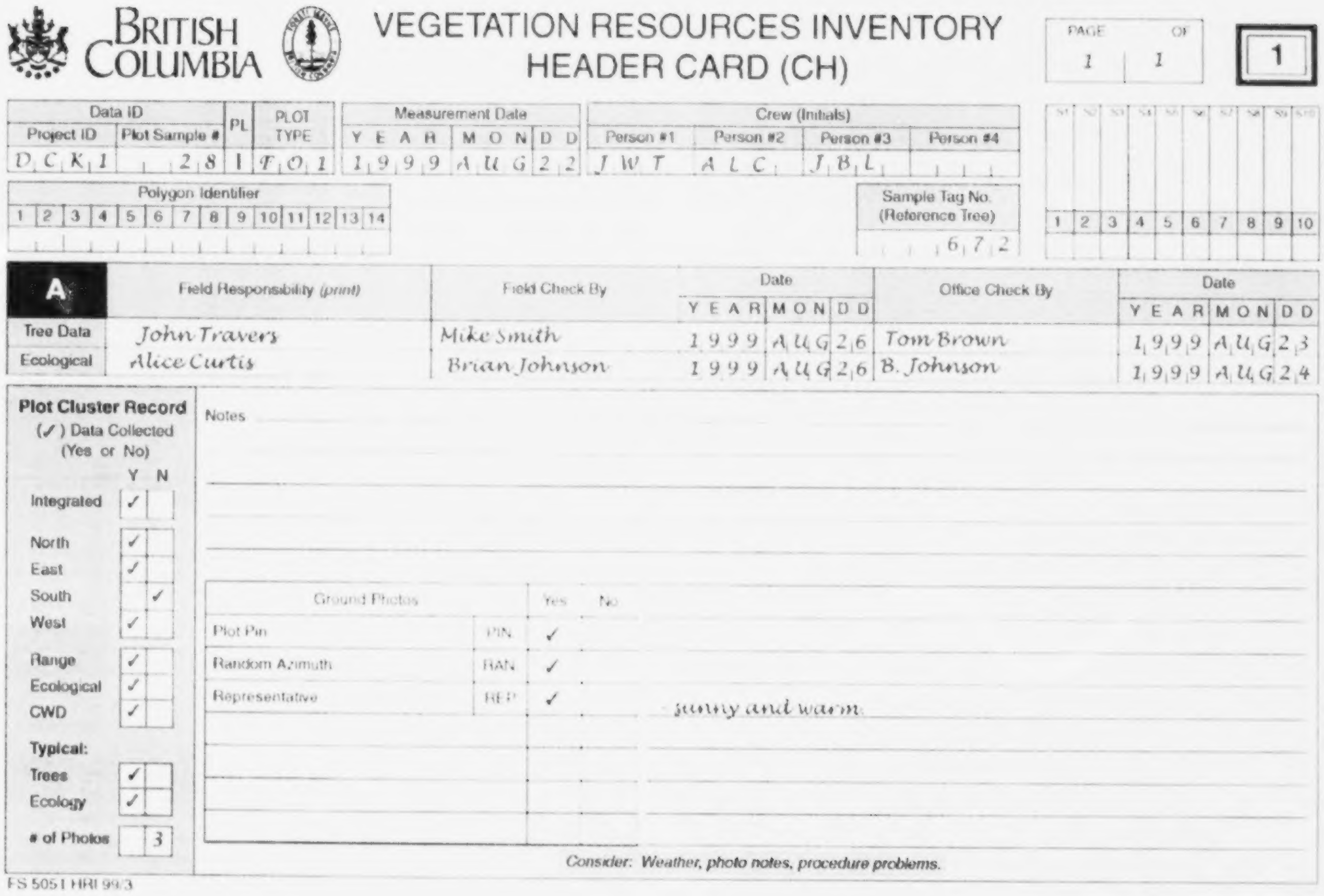


Figure A.2 — Sample field card 1: Header Card (CH) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
HEADER CARD (CH)

PAGE 1 OF 1

1

Data ID		PL	PLOT TYPE	Measurement Date			Crew (Initials)			
Project ID	Plot Sample #			YEAR	MON	DD	Person #1	Person #2	Person #3	Person #4
DCK1	28	1	TO1	1999	AUG	22	JWT	ALC	JBL	

S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	2	3	4	5	6	7	8	9	10

Polygon Identifier

1	2	3	4	5	6	7	8	9	10	11	12	13	14

Sample Tag No. (Reference Tree): 672

A	Field Responsibility (print)	Field Check By	Date			Office Check By	Date		
			YEAR	MON	DD		YEAR	MON	DD
Tree Data	John Travers	Mike Smith	1999	AUG	26	Tom Brown	1999	AUG	23
Ecological	Alice Curtis	Brian Johnson	1999	AUG	26	B. Johnson	1999	AUG	24

Plot Cluster Record
(✓) Data Collected (Yes or No)

	Y	N
Integrated	✓	
North	✓	
East	✓	
South		✓
West	✓	
Range	✓	
Ecological	✓	
CWD	✓	
Typical:		
Trees	✓	
Ecology	✓	
# of Photos		3

Notes

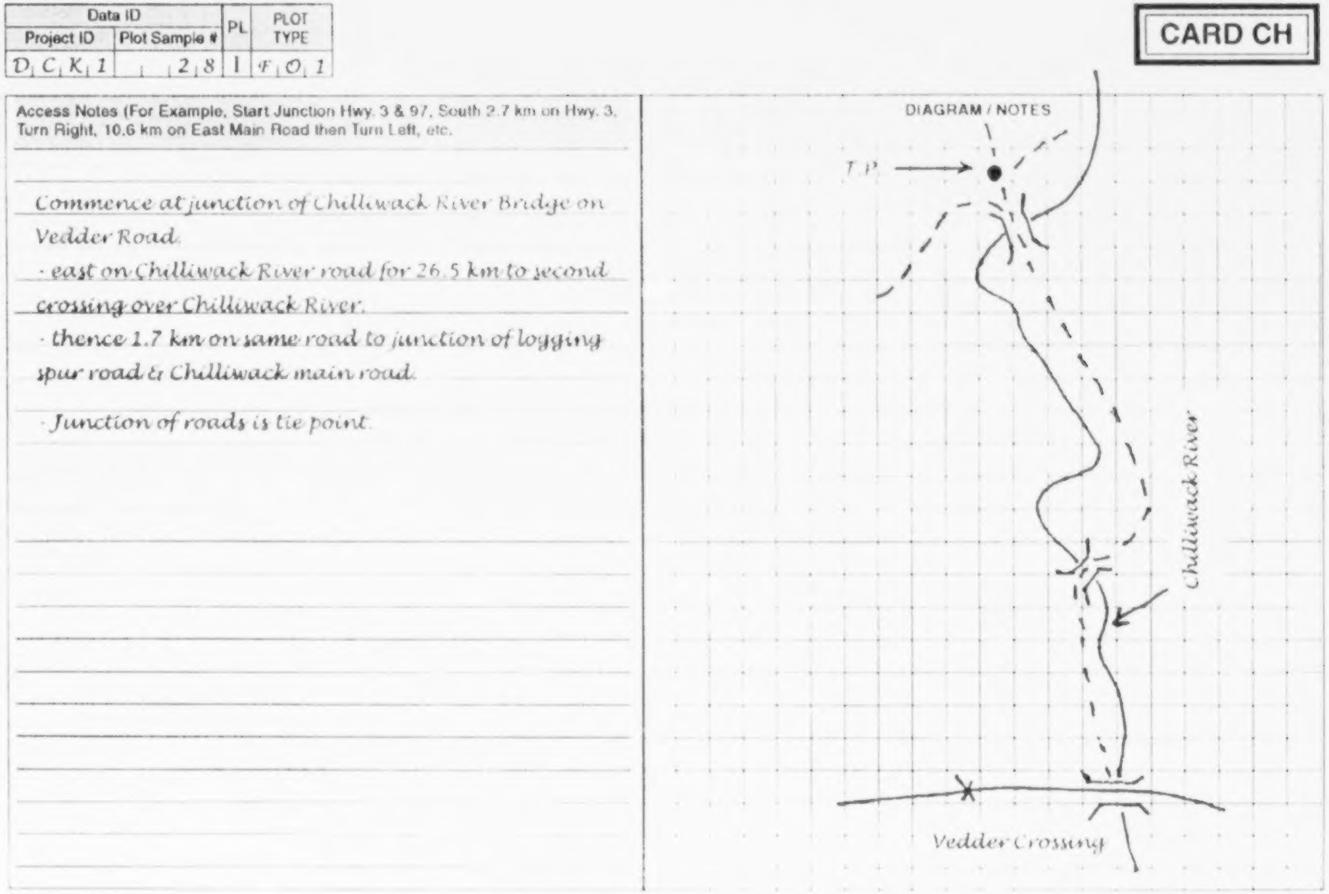
Ground Photos		Yes	No
Plot Pin	PIN	✓	
Random Azimuth	RAN	✓	
Representative	REP	✓	

sunny and warm

Consider: Weather, photo notes, procedure problems.

FS 5051 HRI 99/3

Figure A.1 — Sample field card 1: Header Card (CH) (front)



CARD CH

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Access Notes (For Example, Start Junction Hwy. 3 & 97, South 2.7 km on Hwy. 3, Turn Right, 10.6 km on East Main Road then Turn Left, etc.

Commence at junction of Chilliwack River Bridge on Vedder Road.

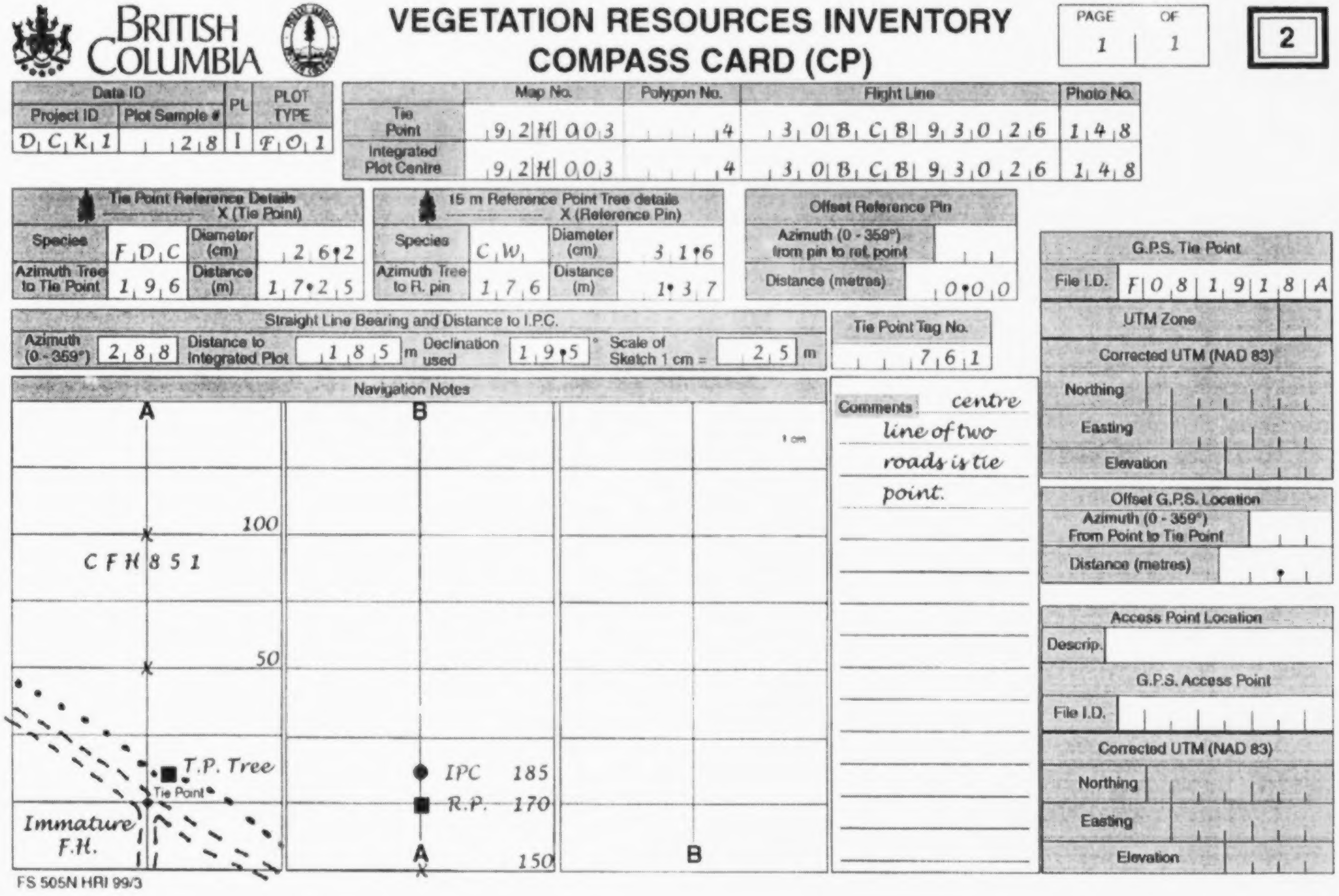
- east on Chilliwack River road for 26.5 km to second crossing over Chilliwack River.

- thence 1.7 km on same road to junction of logging spur road & Chilliwack main road.

- Junction of roads is tie point.

DIAGRAM / NOTES

Figure A.2 — Sample field card 1: Header Card (CH) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY COMPASS CARD (CP)

PAGE 1 OF 1

2

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	I	F O 1

	Map No.	Polygon No.	Flight Line	Photo No.
Tie Point	9 2 H 0 0 3	4	3 0 B C B 9 3 0 2 6	1 4 8
Integrated Plot Centre	9 2 H 0 0 3	4	3 0 B C B 9 3 0 2 6	1 4 8

Tie Point Reference Details X (Tie Point)

Species	F D C	Diameter (cm)	2 6•2
Azimuth Tree to Tie Point	1 9 6	Distance (m)	1 7•2 5

15 m Reference Point Tree details X (Reference Pin)

Species	C W	Diameter (cm)	3 1•6
Azimuth Tree to R. pin	1 7 6	Distance (m)	1• 3 7

Offset Reference Pin

Azimuth (0 - 359°) from pin to ref. point	
Distance (metres)	0•0 0

Straight Line Bearing and Distance to I.P.C.

Azimuth (0 - 359°) 2 8 8 Distance to Integrated Plot 1 8 5 m Declination used 1 9•5 ° Scale of Sketch 1 cm = 2 5 m

Tie Point Tag No. 7 6 1

Navigation Notes

Comments centre line of two roads is tie point.

G.P.S. Tie Point

File I.D.	F 0 8 1 9 1 8 A
UTM Zone	

Corrected UTM (NAD 83)

Northing	
Easting	
Elevation	

Offset G.P.S. Location

Azimuth (0 - 359°) From Point to Tie Point	
Distance (metres)	•

Access Point Location

Descrip.	

G.P.S. Access Point

File I.D.	

Corrected UTM (NAD 83)

Northing	
Easting	
Elevation	

FS 505N HRI 99/3

Figure A.3 — Sample field card 2: Compass Card (front) (CP)

CARD CP

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

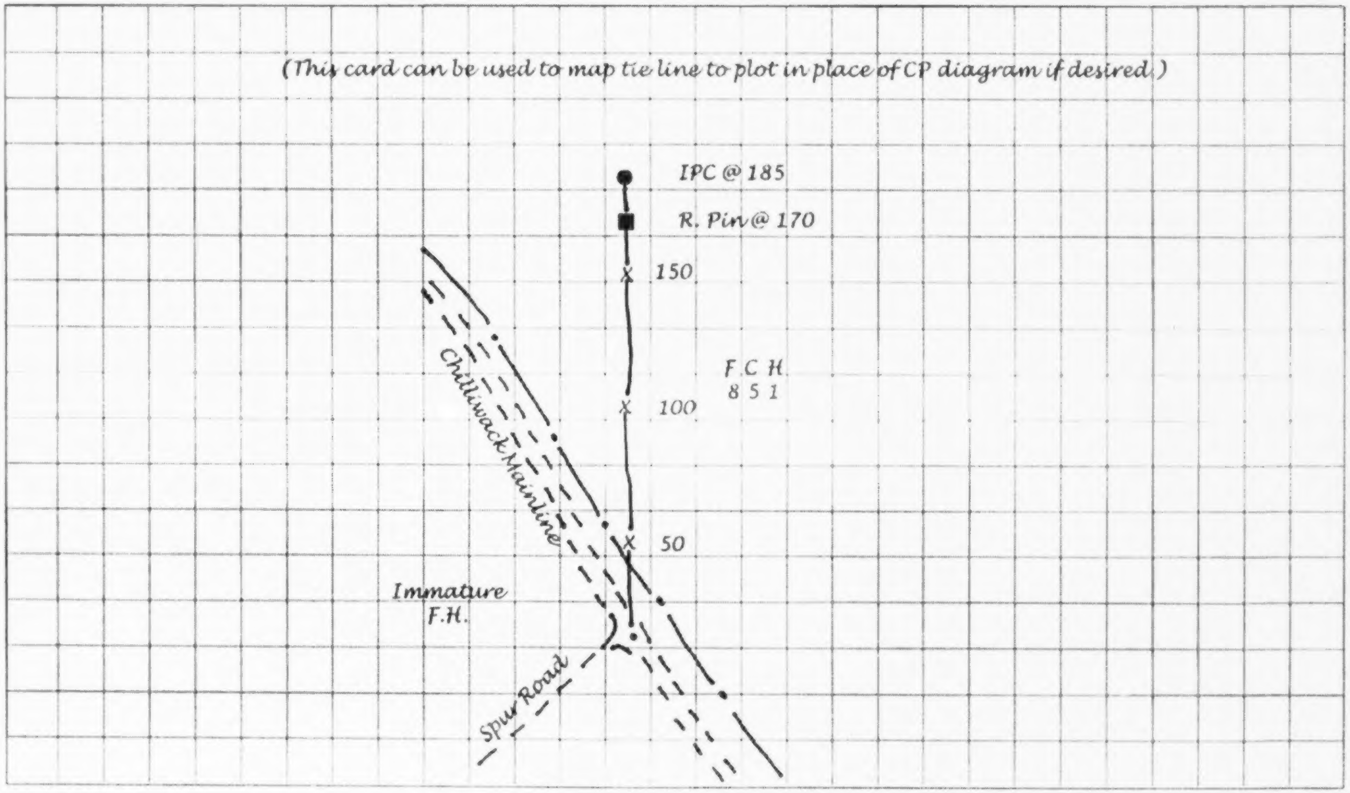
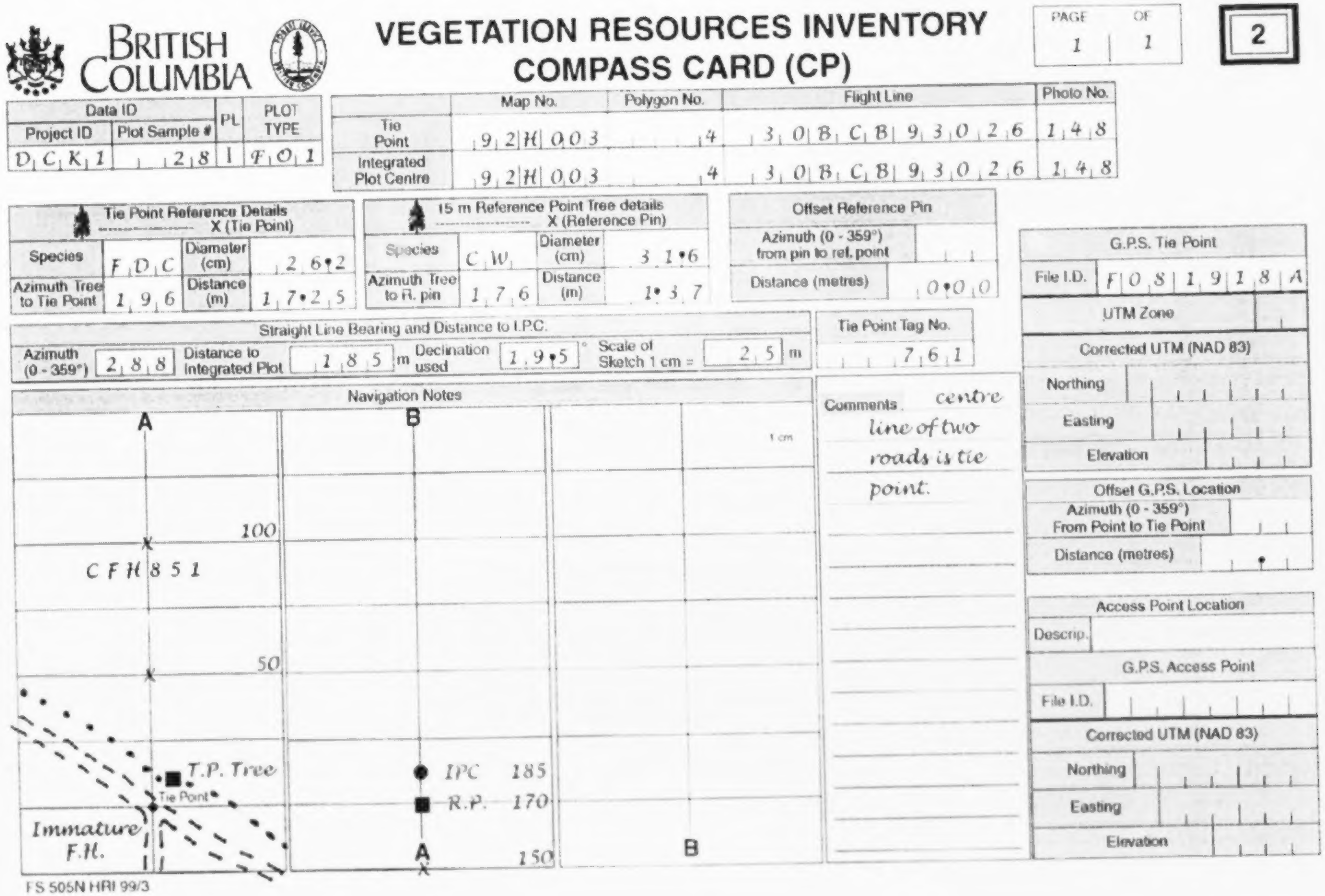

(This card can be used to map tie line to plot in place of CP diagram if desired.)

Figure A.4 — Sample field card 2: Compass Card (CP) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY COMPASS CARD (CP)

PAGE 1 OF 1

2

Data ID			
Project ID	Plot Sample #	PL	PLOT TYPE
DCK1	28	1	FO1

	Map No.	Polygon No.	Flight Line	Photo No.
Tie Point	92H003	4	30BCB93026	148
Integrated Plot Centre	92H003	4	30BCB93026	148

Tie Point Reference Details X (Tie Point)

Species	FDC	Diameter (cm)	26•2
Azimuth Tree to Tie Point	196	Distance (m)	17•25

15 m Reference Point Tree details X (Reference Pin)

Species	CW	Diameter (cm)	31•6
Azimuth Tree to R. pin	176	Distance (m)	1•37

Offset Reference Pin

Azimuth (0 - 359°) from pin to ref. point	
Distance (metres)	0•00

G.P.S. Tie Point

File I.D.	F081918A
UTM Zone	
Corrected UTM (NAD 83)	
Northing	
Easting	
Elevation	

Straight Line Bearing and Distance to I.P.C.

Azimuth (0 - 359°) 288 Distance to Integrated Plot 185 m Declination used 19•5° Scale of Sketch 1 cm = 25 m

Tie Point Tag No. 761

Navigation Notes

Comments centre line of two roads is tie point.

Offset G.P.S. Location

Azimuth (0 - 359°) From Point to Tie Point	
Distance (metres)	•

Access Point Location

Descrip.	

G.P.S. Access Point

File I.D.	
Corrected UTM (NAD 83)	
Northing	
Easting	
Elevation	

FS 505N HRI 99/3

Figure A.3 — Sample field card 2: Compass Card (front) (CP)

CARD CP

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	I	F O 1

(This card can be used to map tie line to plot in place of CP diagram if desired.)

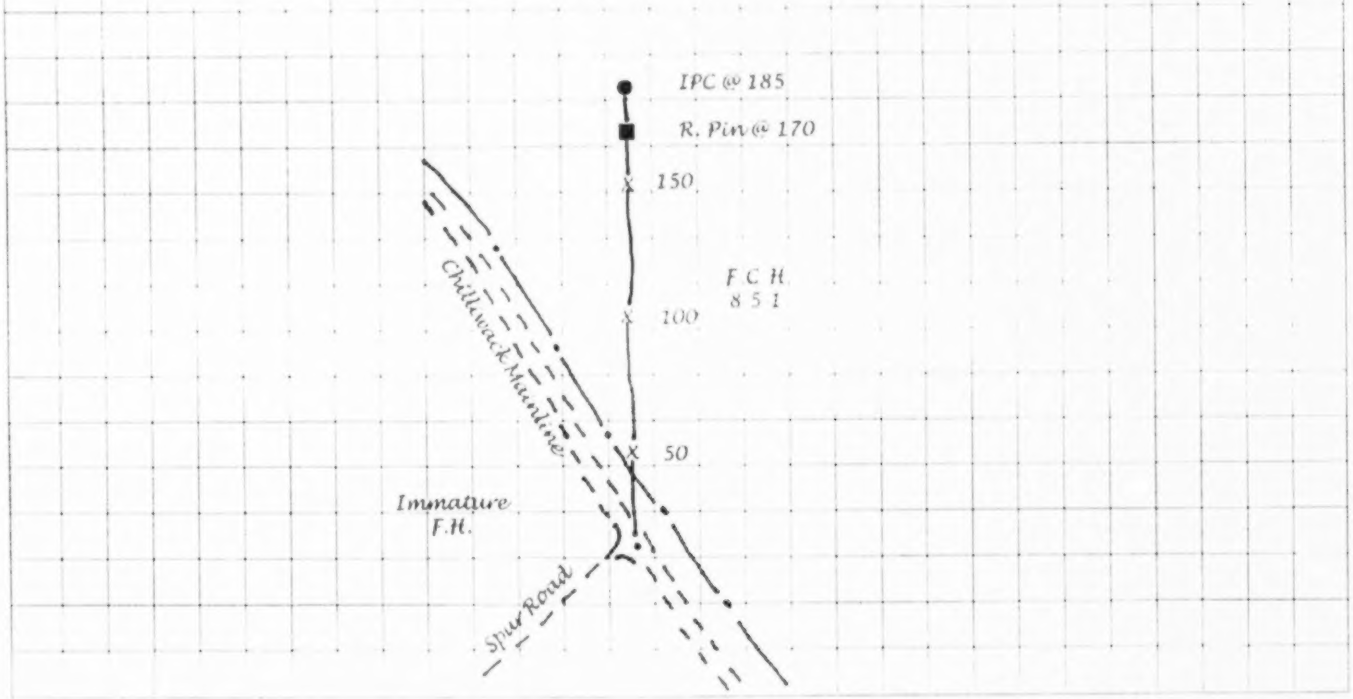
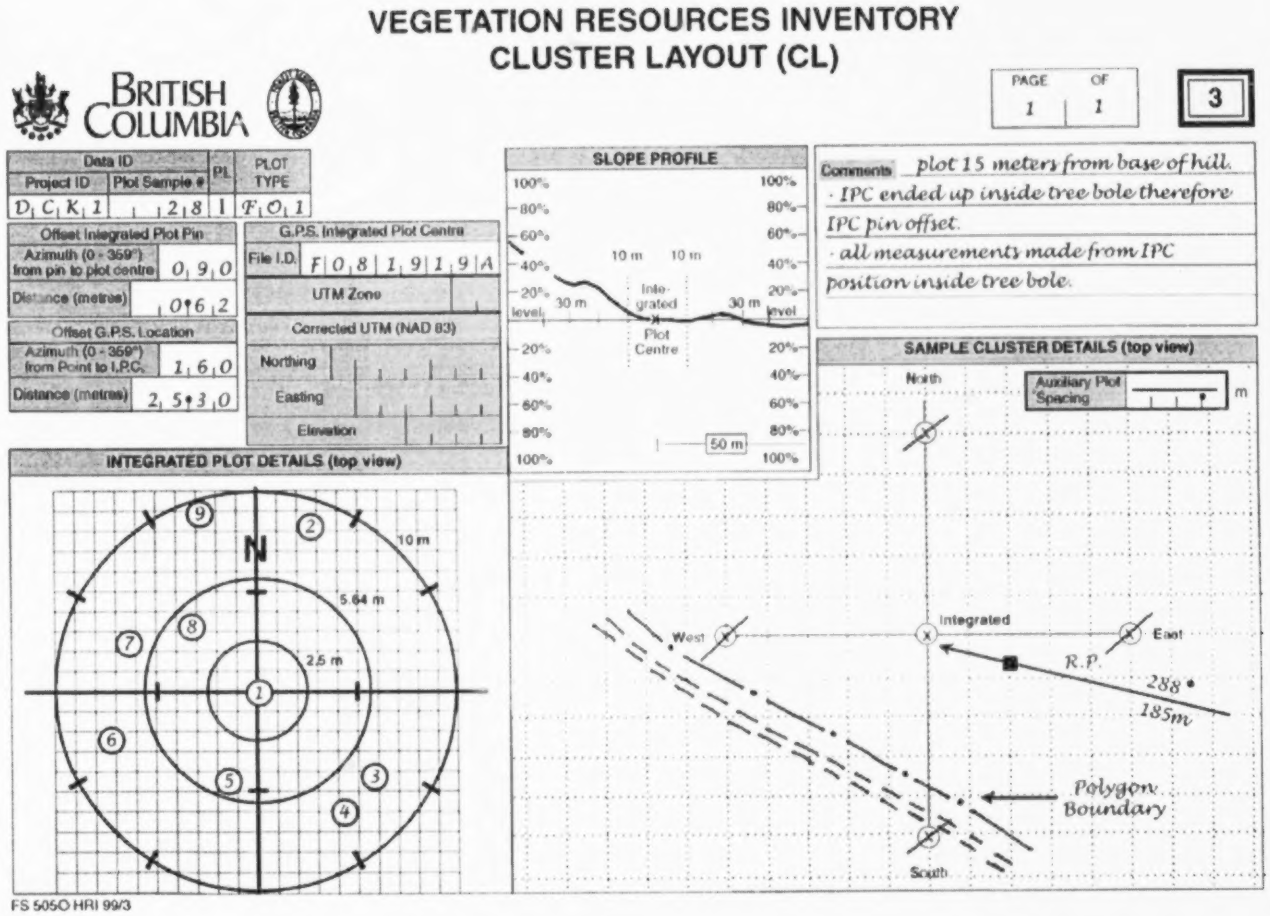


Figure A.4 — Sample field card 2: Compass Card (CP) (reverse)



VEGETATION RESOURCES INVENTORY
CLUSTER LAYOUT (CL)

BRITISH COLUMBIA

PAGE	OF
1	1

3

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
DCK1	28	1	FO1

Offset Integrated Plot Pin	
Azimuth (0 - 359°) from pin to plot centre	090
Distance (metres)	0•62

Offset G.P.S. Location	
Azimuth (0 - 359°) from Point to I.P.C.	160
Distance (metres)	25•30

G.P.S. Integrated Plot Centre	
File I.D.	F08 19 19 A
UTM Zone	
Corrected UTM (NAD 83)	
Northing	
Easting	
Elevation	

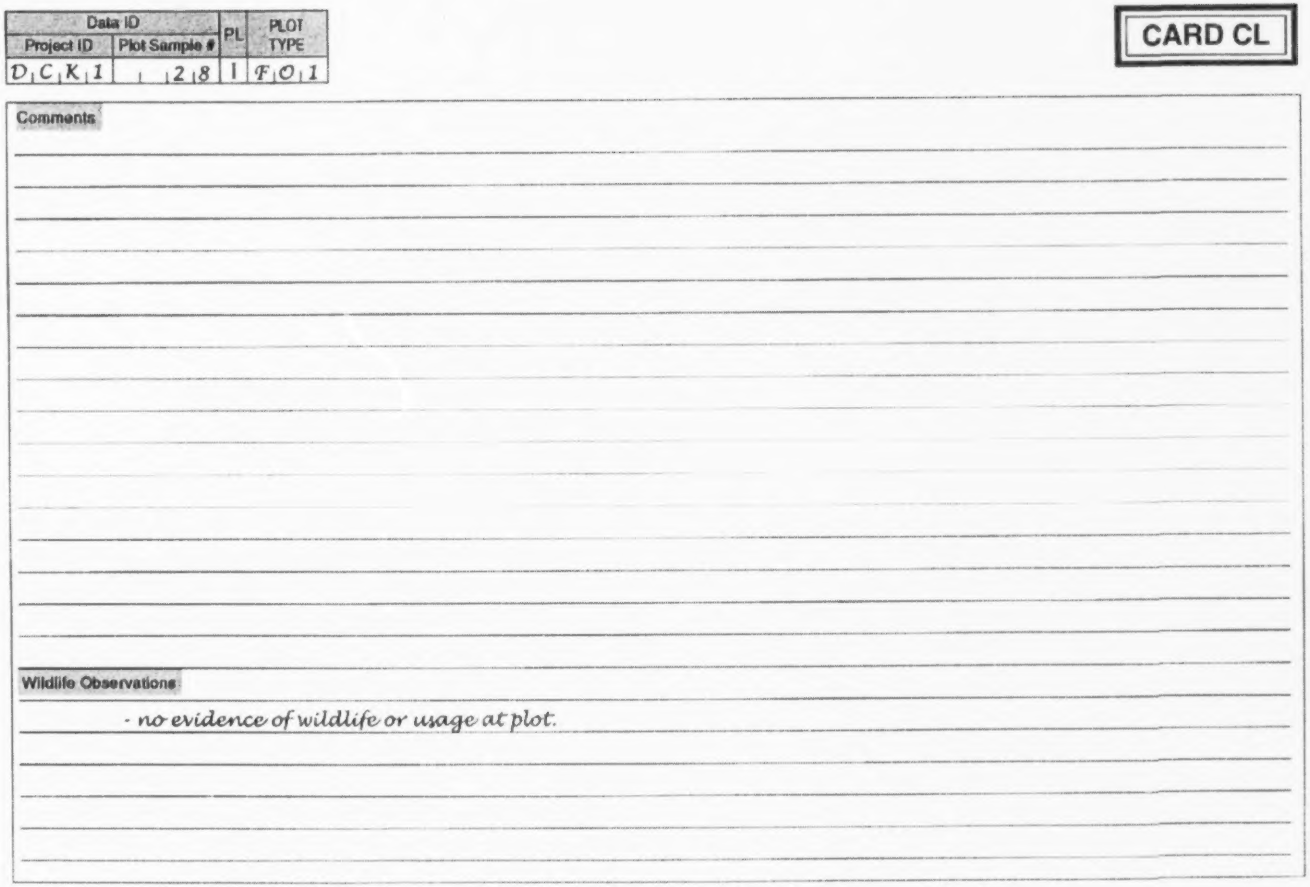
Comments plot 15 meters from base of hill.
· IPC ended up inside tree bole therefore
IPC pin offset.
· all measurements made from IPC
position inside tree bole.

SAMPLE CLUSTER DETAILS (top view)

Auxiliary Plot Spacing m

FS 505O HRI 99/3

Figure A.5 — Sample field card 3: Cluster Layout (CL) (front)



CARD CL

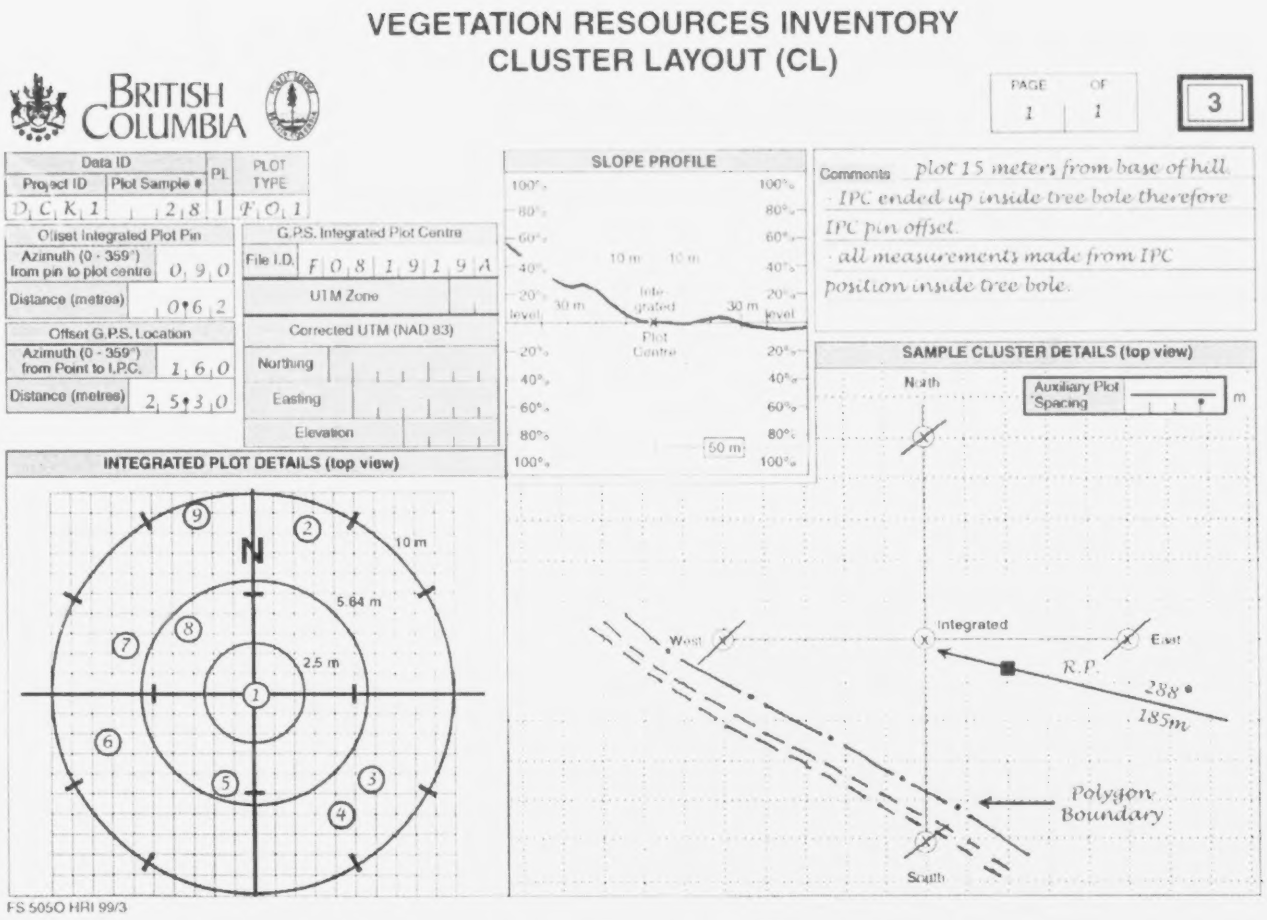
Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Comments

Wildlife Observations

- no evidence of wildlife or usage at plot.

Figure A.6 — Sample field card 3: Cluster Layout (CL) (reverse)



VEGETATION RESOURCES INVENTORY
CLUSTER LAYOUT (CL)

BRITISH COLUMBIA

PAGE 1 OF 1

3

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Offset Integrated Plot Pin	
Azimuth (0 - 359°) from pin to plot centre	0 9 0
Distance (metres)	0•6 2

Offset G.P.S. Location	
Azimuth (0 - 359°) from Point to I.P.C.	1 6 0
Distance (metres)	2 5•3 0

G.P.S. Integrated Plot Centre	
File I.D.	F 0 8 1 9 1 9 A
UTM Zone	
Corrected UTM (NAD 83)	
Northing	
Easting	
Elevation	

Comments plot 15 meters from base of hill.
- IPC ended up inside tree bole therefore IPC pin offset.
- all measurements made from IPC position inside tree bole.

Auxiliary Plot Spacing ______ m

FS 505O HRI 99/3

Figure A.5 — Sample field card 3: Cluster Layout (CL) (front)

CARD CL

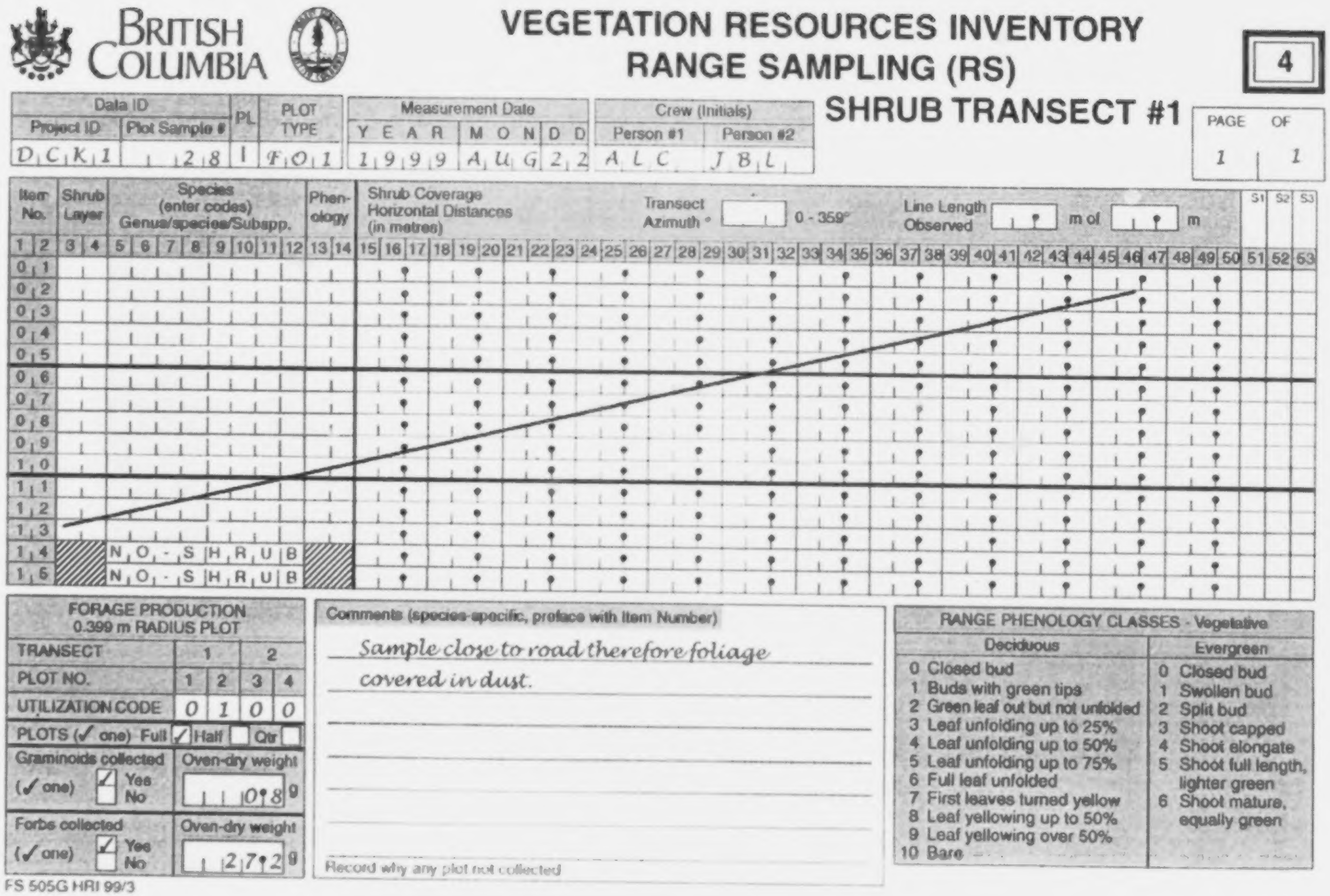
Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Comments

Wildlife Observations

- no evidence of wildlife or usage at plot.

Figure A.6 — Sample field card 3: Cluster Layout (CL) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
RANGE SAMPLING (RS)
SHRUB TRANSECT #1

4

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE	Measurement Date: YEAR	MON	DD	Crew (Initials): Person #1	Person #2	PAGE	OF
DCK1	28	I	FO1	1999	AUG	22	ALC	JBL	1	1

Transcribe Azimuth ° ☐ 0 - 359°   Line Length Observed ☐ . m of ☐ . m

Item No. (1 2)	Shrub Layer (3 4)	Species (enter codes) Genus/species/Subspp. (5–12)	Phenology (13 14)	Shrub Coverage Horizontal Distances (in metres) (15–50)	S1	S2	S3
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14	▨	NO-SHRUB	▨				
15	▨	NO-SHRUB	▨				

FORAGE PRODUCTION
0.399 m RADIUS PLOT

TRANSECT	1		2	
PLOT NO.	1	2	3	4
UTILIZATION CODE	0	1	0	0

PLOTS (✓ one) Full ☑ Half ☐ Qtr ☐

Graminoids collected (✓ one) ☑ Yes ☐ No — Oven-dry weight 0.8 g

Forbs collected (✓ one) ☑ Yes ☐ No — Oven-dry weight 27.2 g

FS 505G HRI 99/3

Comments (species-specific, preface with Item Number)

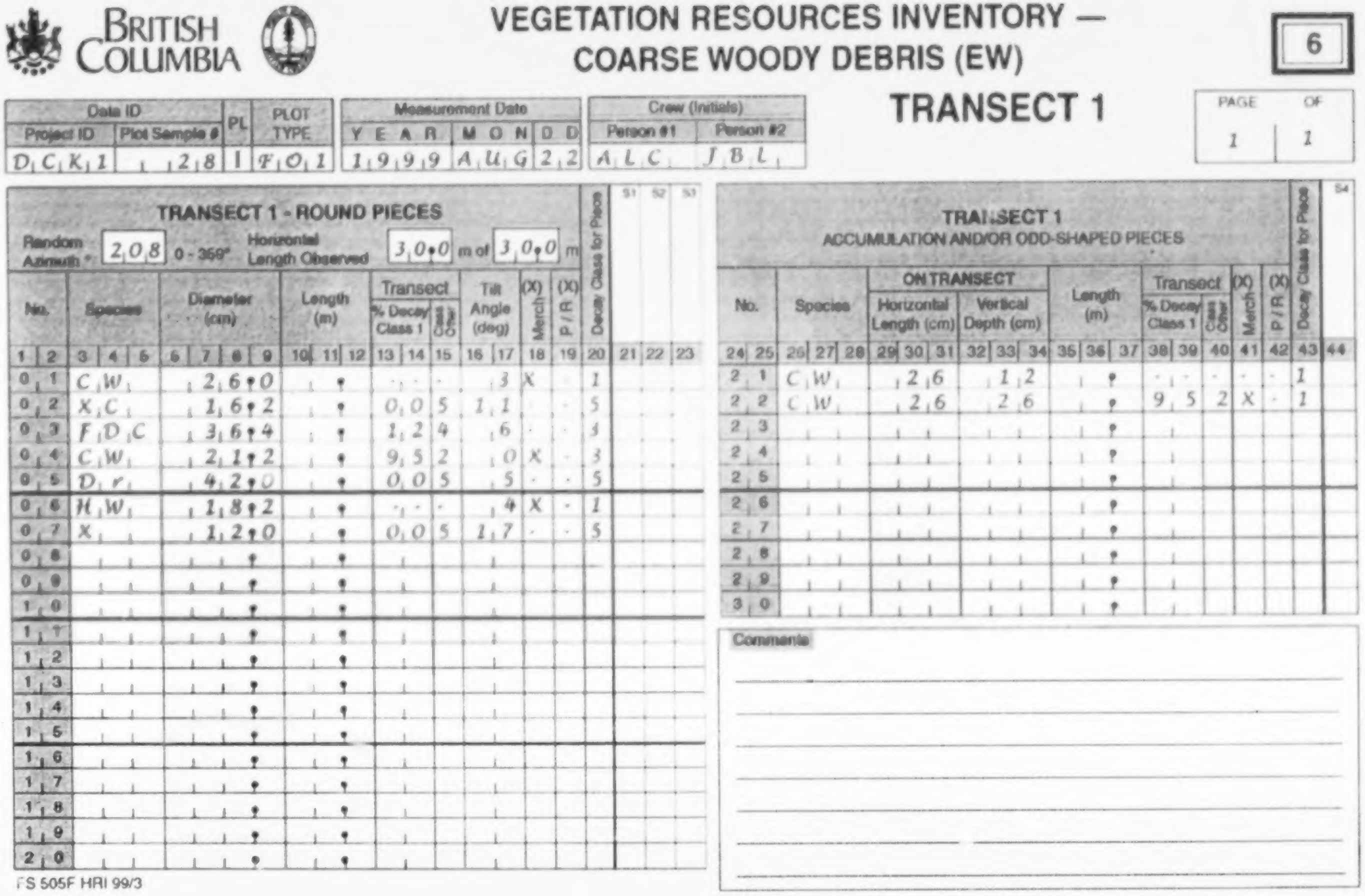
Sample close to road therefore foliage
covered in dust.

Record why any plot not collected

RANGE PHENOLOGY CLASSES - Vegetative

Deciduous	Evergreen
0 Closed bud	0 Closed bud
1 Buds with green tips	1 Swollen bud
2 Green leaf out but not unfolded	2 Split bud
3 Leaf unfolding up to 25%	3 Shoot capped
4 Leaf unfolding up to 50%	4 Shoot elongate
5 Leaf unfolding up to 75%	5 Shoot full length, lighter green
6 Full leaf unfolded	6 Shoot mature, equally green
7 First leaves turned yellow	
8 Leaf yellowing up to 50%	
9 Leaf yellowing over 50%	
10 Bare	

Figure A.7 — Sample field card 4: Range Sampling (RS) (shrub transect 1)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — COARSE WOODY DEBRIS (EW)

6

TRANSECT 1

Data ID		PL	PLOT TYPE	Measurement Date			Crew (Initials)	
Project ID	Plot Sample #			YEAR	MON	DD	Person #1	Person #2
DCK1	28	I	FO1	1999	AUG	22	ALC	JBL

PAGE	OF
1	1

TRANSECT 1 - ROUND PIECES

Random Azimuth ° 208 0 - 360° Horizontal Length Observed 30.0 m of 30.0 m

No.	Species	Diameter (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	Tilt Angle (deg)	(X) Merch	(X) P / R	Decay Class for Piece	S1	S2	S3
1 2	3 4 5	6 7 8 9	10 11 12	13 14	15	16 17	18	19	20	21	22	23
01	CW	26.0	.	-	-	3	X	-	1			
02	XC	16.2	.	00	5	11	-	-	5			
03	FDC	36.4	.	12	4	6	-	-	3			
04	CW	21.2	.	95	2	0	X	-	3			
05	Dr	42.0	.	00	5	5	-	-	5			
06	HW	18.2	.	-	-	4	X	-	1			
07	X	12.0	.	00	5	17	-	-	5			
08		.	.									
09		.	.									
10		.	.									
11		.	.									
12		.	.									
13		.	.									
14		.	.									
15		.	.									
16		.	.									
17		.	.									
18		.	.									
19		.	.									
20		.	.									

FS 505F HRI 99/3

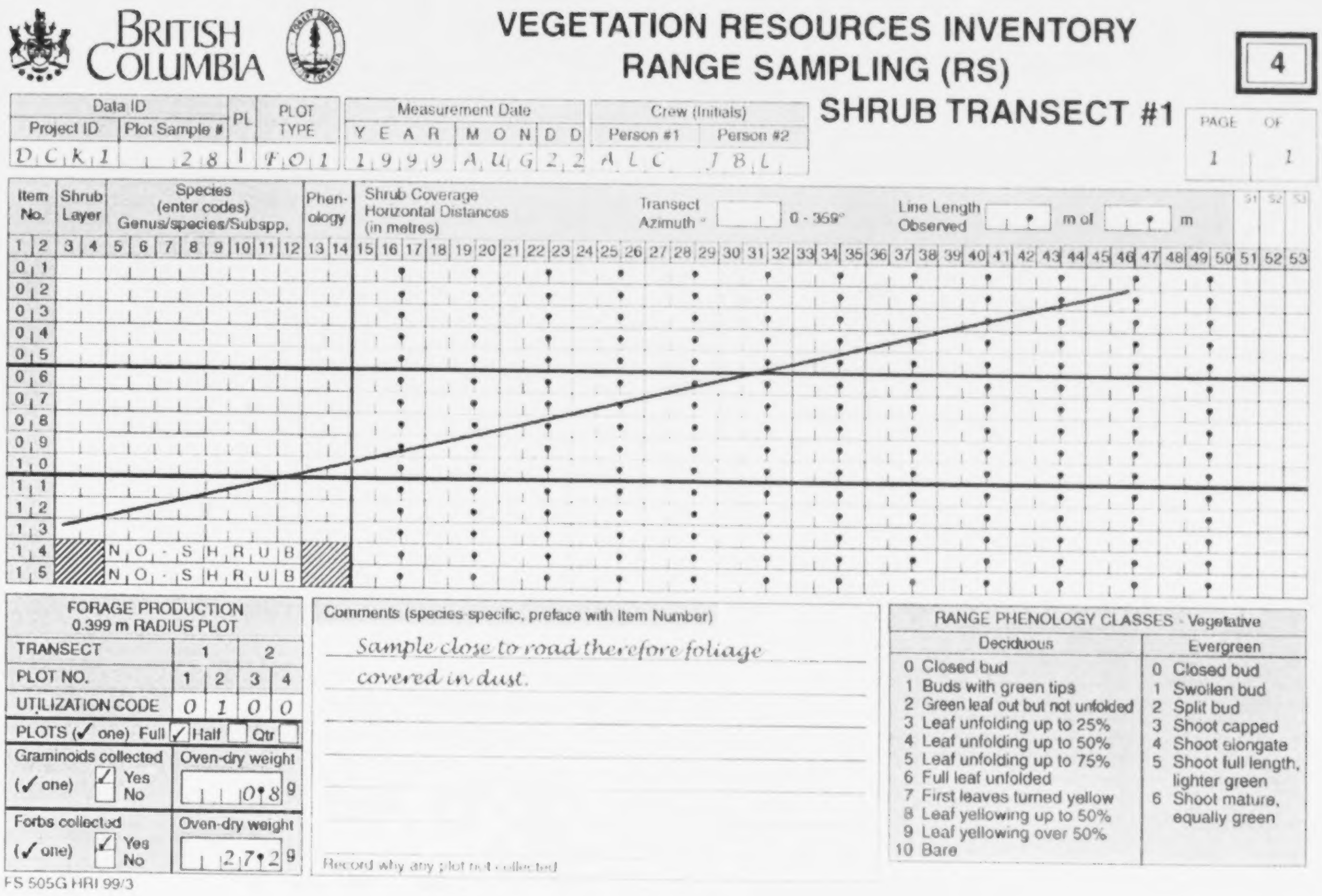
TRANSECT 1

ACCUMULATION AND/OR ODD-SHAPED PIECES

No.	Species	ON TRANSECT Horizontal Length (cm)	ON TRANSECT Vertical Depth (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	(X) Merch	(X) P / R	Decay Class for Piece	S4
24 25	26 27 28	29 30 31	32 33 34	35 36 37	38 39	40	41	42	43	44
21	CW	26	12	.	-	-	-	-	1	
22	CW	26	26	.	95	2	X	-	1	
23				.						
24				.						
25				.						
26				.						
27				.						
28				.						
29				.						
30				.						

Comments

Figure A.8 — Sample field card 6: Coarse Woody Debris (EW) (Transect 1).



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
RANGE SAMPLING (RS)

4

SHRUB TRANSECT #1

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE	Measurement Date: YEAR	MON	DD	Crew (Initials): Person #1	Person #2	PAGE	OF
DCK1	28	1	FO1	1999	AUG	22	ALC	JBL	1	1

Transcect Azimuth ° 0 - 359°

Line Length Observed . m of . m

Item No. (1 2)	Shrub Layer (3 4)	Species (enter codes) Genus/species/Subspp. (5–12)	Phenology (13 14)	Shrub Coverage Horizontal Distances (in metres) (15–53)
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14	▨	NO-SHRUB	▨	
15	▨	NO-SHRUB	▨	

FORAGE PRODUCTION
0.399 m RADIUS PLOT

TRANSECT	1		2	
PLOT NO.	1	2	3	4
UTILIZATION CODE	0	1	0	0

PLOTS (✓ one) Full ☑ Half ☐ Qtr ☐

Graminoids collected (✓ one) ☑ Yes ☐ No — Oven-dry weight 0.8 g

Forbs collected (✓ one) ☑ Yes ☐ No — Oven-dry weight 2.72 g

Comments (species specific, preface with Item Number)

Sample close to road therefore foliage covered in dust.

Record why any plot not collected

RANGE PHENOLOGY CLASSES - Vegetative

Deciduous	Evergreen
0 Closed bud	0 Closed bud
1 Buds with green tips	1 Swollen bud
2 Green leaf out but not unfolded	2 Split bud
3 Leaf unfolding up to 25%	3 Shoot capped
4 Leaf unfolding up to 50%	4 Shoot elongate
5 Leaf unfolding up to 75%	5 Shoot full length, lighter green
6 Full leaf unfolded	6 Shoot mature, equally green
7 First leaves turned yellow	
8 Leaf yellowing up to 50%	
9 Leaf yellowing over 50%	
10 Bare	

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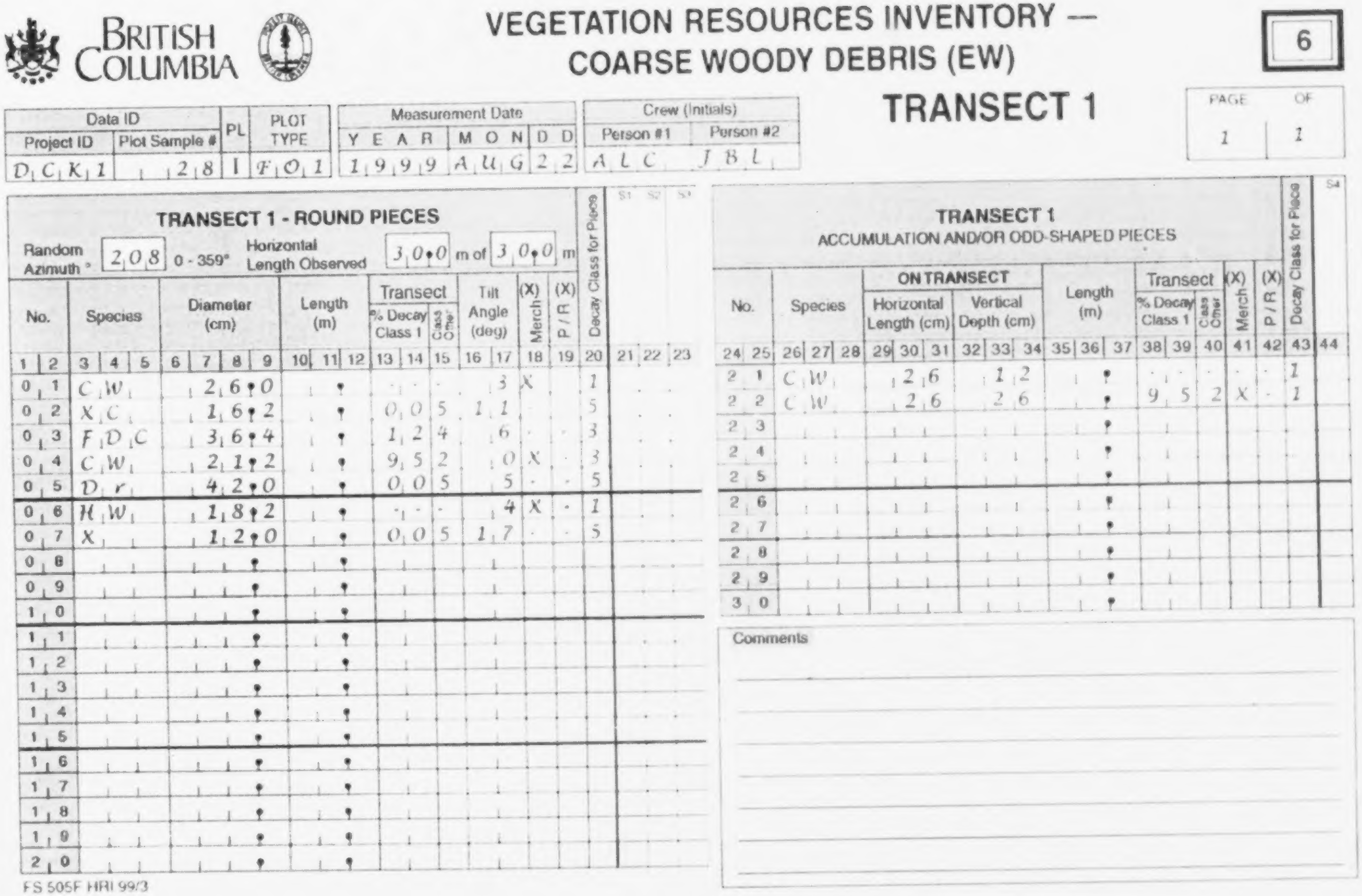
Figure A.7 — Sample field card 4: Range Sampling (RS) (shrub transect 1)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — COARSE WOODY DEBRIS (EW)

TRANSECT 1

6

PAGE 1 OF 1

Project ID	Plot Sample #	PL	PLOT TYPE	YEAR	MON	DD	Person #1	Person #2
DCK1	28	I	FO1	1999	AUG	22	ALC	JBL

TRANSECT 1 - ROUND PIECES

Random Azimuth ° 208 0 - 359° Horizontal Length Observed 30.0 m of 30.0 m

No. (1–2)	Species (3–5)	Diameter (cm) (6–9)	Length (m) (10–12)	Transect % Decay Class 1 (13–14)	Transect Class Other (15)	Tilt Angle (deg) (16–17)	(X) Merch (18)	(X) P / R (19)	Decay Class for Piece (20)	21	22	23
01	CW	26.0	.	-	-	3	X		1			
02	XC	16.2	.	00	5	11	-		5			
03	FDC	36.4	.	12	4	6	-	-	3			
04	CW	21.2	.	95	2	0	X	-	3			
05	Dr	42.0	.	00	5	5	-	-	5			
06	HW	18.2	.	-	-	4	X	-	1			
07	X	12.0	.	00	5	17	-	-	5			
08		.	.									
09		.	.									
10		.	.									
11		.	.									
12		.	.									
13		.	.									
14		.	.									
15		.	.									
16		.	.									
17		.	.									
18		.	.									
19		.	.									
20		.	.									

S1 S2 S3

TRANSECT 1

ACCUMULATION AND/OR ODD-SHAPED PIECES

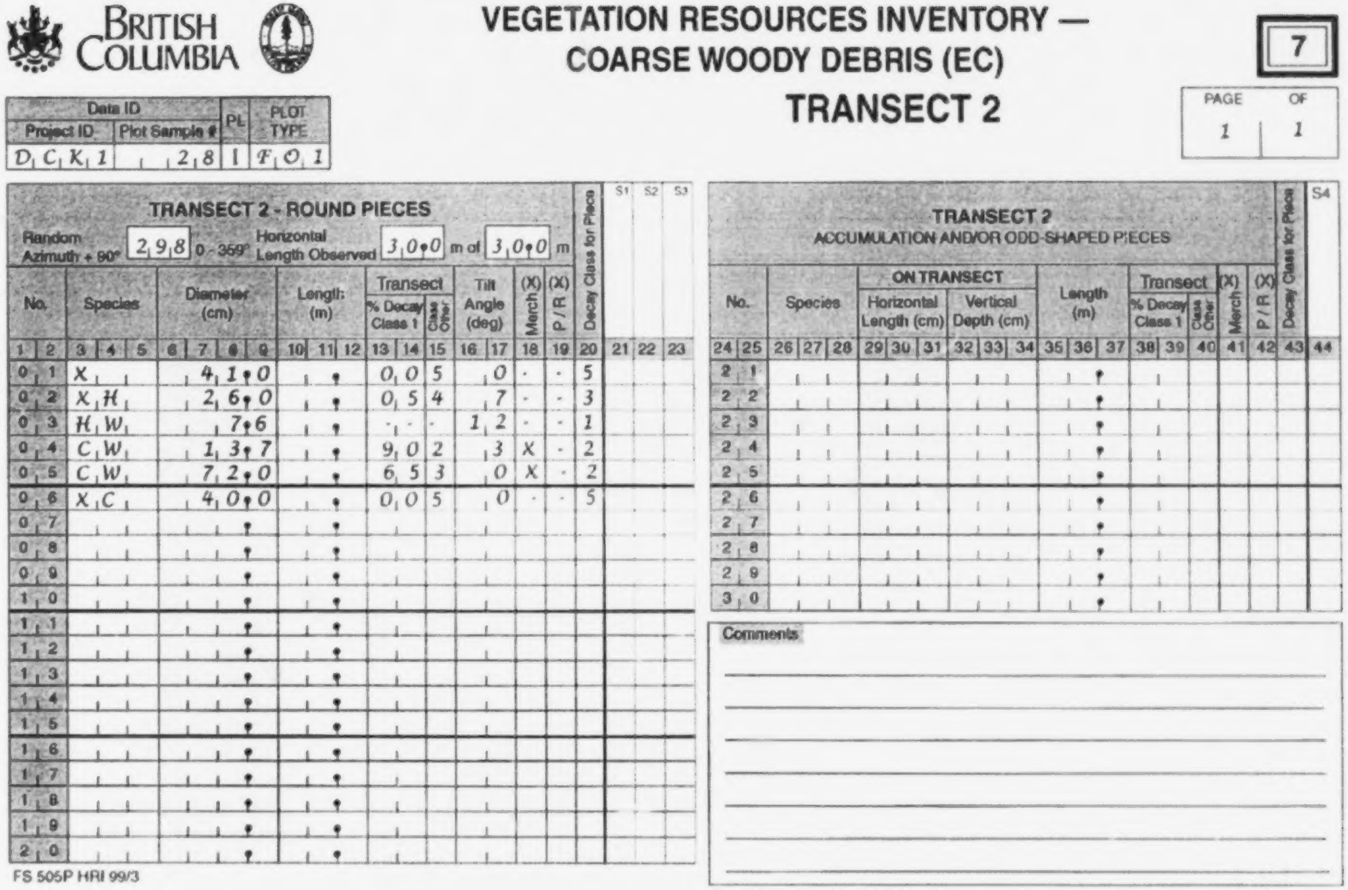
No. (24–25)	Species (26–28)	ON TRANSECT Horizontal Length (cm) (29–31)	ON TRANSECT Vertical Depth (cm) (32–34)	Length (m) (35–37)	Transect % Decay Class 1 (38–39)	Transect Class Other (40)	(X) Merch (41)	(X) P / R (42)	Decay Class for Piece (43)	44
21	CW	26	12	.	-	-	-	-	1	
22	CW	26	26	.	95	2	X	-	1	
23				.						
24				.						
25				.						
26				.						
27				.						
28				.						
29				.						
30				.						

S4

Comments

FS 505F HRI 99/3

Figure A.8 — Sample field card 6: Coarse Woody Debris (EW) (Transect 1).



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — COARSE WOODY DEBRIS (EC)

TRANSECT 2

7

PAGE	OF
1	1

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE
DCK1	28	I	FO1

TRANSECT 2 - ROUND PIECES

Random Azimuth + 90° 298 0 - 359° Horizontal Length Observed 30.0 m of 30.0 m

No.	Species	Diameter (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	Tilt Angle (deg)	(X) Merch	(X) P/R	Decay Class for Piece	S1	S2	S3
1 2	3 4 5	6 7 8 9	10 11 12	13 14	15	16 17	18	19	20	21	22	23
01	X	41.0	.	00	5	0	·	·	5			
02	XH	26.0	.	05	4	7	·	·	3			
03	HW	7.6	.	- -	-	12	·	·	1			
04	CW	13.7	.	90	2	3	X	·	2			
05	CW	72.0	.	65	3	0	X	·	2			
06	XC	40.0	.	00	5	0	·	·	5			
07		.	.									
08		.	.									
09		.	.									
10		.	.									
11		.	.									
12		.	.									
13		.	.									
14		.	.									
15		.	.									
16		.	.									
17		.	.									
18		.	.									
19		.	.									
20		.	.									

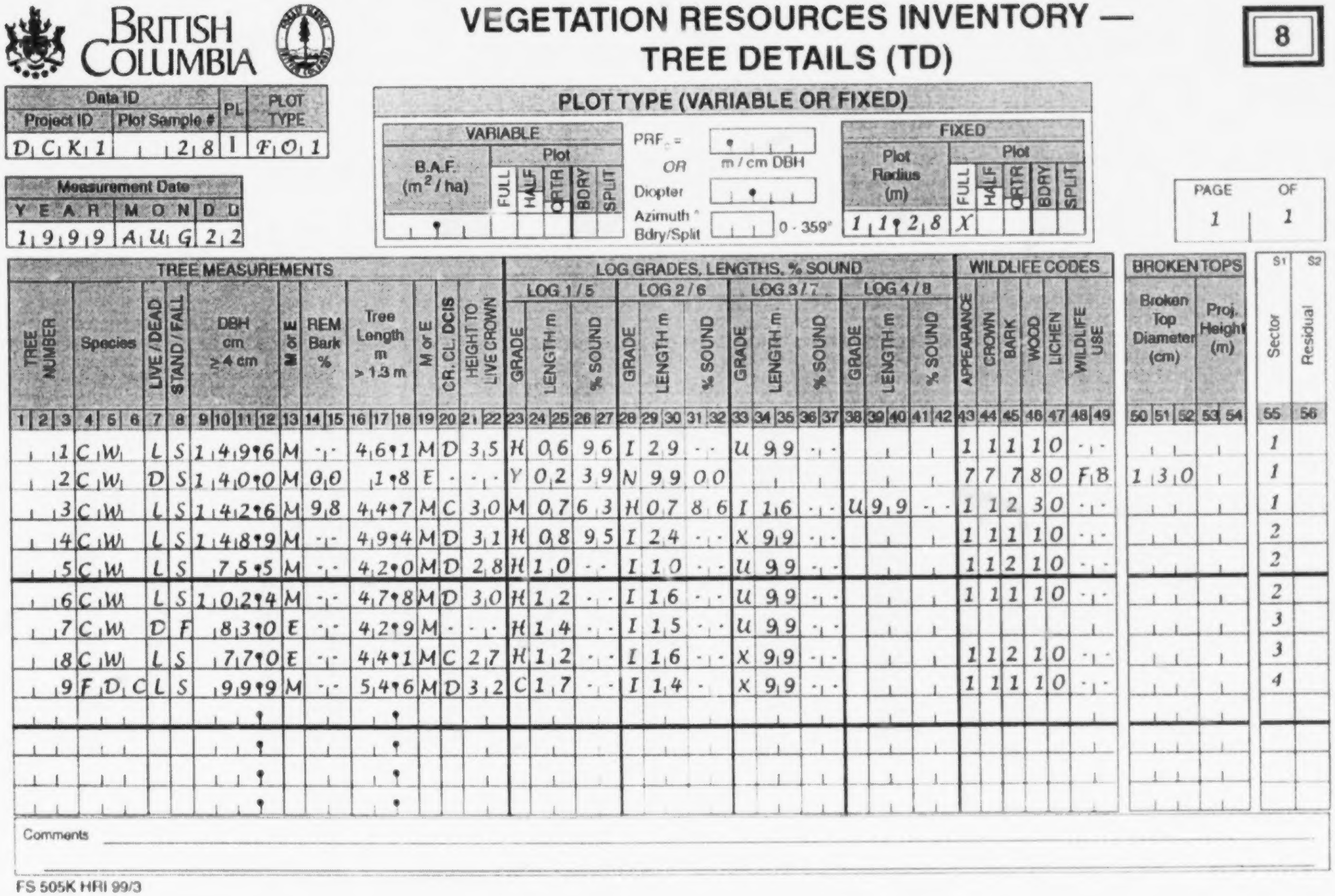
FS 505P HRI 99/3

TRANSECT 2
ACCUMULATION AND/OR ODD-SHAPED PIECES

No.	Species	ON TRANSECT Horizontal Length (cm)	ON TRANSECT Vertical Depth (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	(X) Merch	(X) P/R	Decay Class for Piece	S4
24 25	26 27 28	29 30 31	32 33 34	35 36 37	38 39	40	41	42	43	44
21				.						
22				.						
23				.						
24				.						
25				.						
26				.						
27				.						
28				.						
29				.						
30				.						

Comments

Figure A.9 — Sample field card 7: Coarse Woody Debris (EC) (Transect 2)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY —
TREE DETAILS (TD)

8

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE
DCK1	28	1	FO1

Measurement Date: YEAR	MON	DD
1999	AUG	22

PLOT TYPE (VARIABLE OR FIXED)

VARIABLE: B.A.F. (m² / ha)	Plot: FULL	HALF	QRTR	BDRY	SPLIT
.					

PRF = . m / cm DBH
OR
Diopter .
Azimuth ° Bdry/Split 0 - 359°

FIXED: Plot Radius (m)	Plot: FULL	HALF	QRTR	BDRY	SPLIT
11.28	X				

PAGE 1 OF 1

TREE MEASUREMENTS											LOG GRADES, LENGTHS, % SOUND												WILDLIFE CODES						BROKEN TOPS		S1	S2
											LOG 1/5			LOG 2/6			LOG 3/7			LOG 4/8												
TREE NUMBER	Species	LIVE / DEAD	STAND / FALL	DBH cm ≥ 4 cm	M or E	REM Bark %	Tree Length m > 1.3 m	M or E	CR. CL. DCIS	HEIGHT TO LIVE CROWN	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	APPEARANCE	CROWN	BARK	WOOD	LICHEN	WILDLIFE USE	Broken Top Diameter (cm)	Proj. Height (m)	Sector	Residual
1 2 3	4 5 6	7	8	9 10 11 12	13	14 15	16 17 18	19	20	21 22	23	24 25	26 27	28	29 30	31 32	33	34 35	36 37	38	39 40	41 42	43	44	45	46	47	48 49	50 51 52	53 54	55	56
1	CW	L	S	149.6	M	- -	46.1	M	D	35	H	06	96	I	29	- -	U	99	- -				1	1	1	1	0	- -			1	
2	CW	D	S	140.0	M	00	1.8	E	-	- -	Y	02	39	N	99	00							7	7	7	8	0	FB	130		1	
3	CW	L	S	142.6	M	98	44.7	M	C	30	M	07	63	H	07	86	I	16	- -	U	99	- -	1	1	2	3	0	- -			1	
4	CW	L	S	148.9	M	- -	49.4	M	D	31	H	08	95	I	24	- -	X	99	- -				1	1	1	1	0	- -			2	
5	CW	L	S	75.5	M	- -	42.0	M	D	28	H	10	- -	I	10	- -	U	99	- -				1	1	2	1	0	- -			2	
6	CW	L	S	102.4	M	- -	47.8	M	D	30	H	12	- -	I	16	- -	U	99	- -				1	1	1	1	0	- -			2	
7	CW	D	F	83.0	E	- -	42.9	M	-	- -	H	14	- -	I	15	- -	U	99	- -												3	
8	CW	L	S	77.0	E	- -	44.1	M	C	27	H	12	- -	I	16	- -	X	99	- -				1	1	2	1	0	- -			3	
9	FDC	L	S	99.9	M	- -	54.6	M	D	32	C	17	- -	I	14	-	X	99	- -				1	1	1	1	0	- -			4	
				.			.																									
				.			.																									
				.			.																									
				.			.																									

Comments

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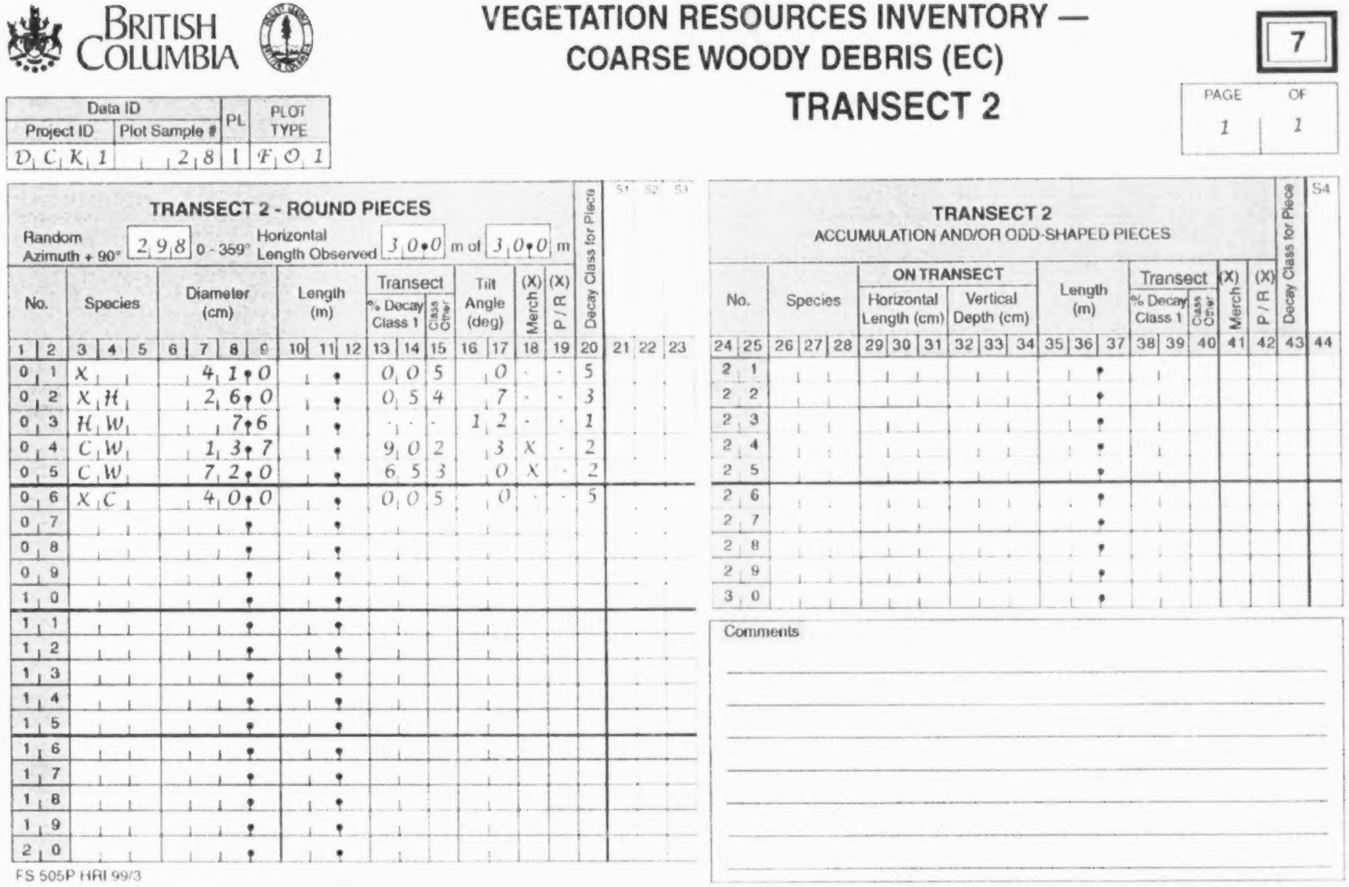
Figure A.10 — Sample field card 8: Tree Details (TD) (front)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — COARSE WOODY DEBRIS (EC)

TRANSECT 2

7

PAGE	OF
1	1

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE
DCK1	28	1	FO1

TRANSECT 2 - ROUND PIECES

Random Azimuth + 90° 298 0 - 359° Horizontal Length Observed 30.0 m of 30.0 m

No.	Species	Diameter (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	Tilt Angle (deg)	(X) Merch	(X) P/R	Decay Class for Piece	S1	S2	S3
1 2	3 4 5	6 7 8 9	10 11 12	13 14	15	16 17	18	19	20	21	22	23
01	X	41.0	.	00	5	0	-	-	5			
02	XH	26.0	.	05	4	7	-	-	3			
03	HW	7.6	.	- -	-	12	-	-	1			
04	CW	13.7	.	90	2	3	X	-	2			
05	CW	72.0	.	65	3	0	X	-	2			
06	XC	40.0	.	00	5	0	-	-	5			
07		.	.									
08		.	.									
09		.	.									
10		.	.									
11		.	.									
12		.	.									
13		.	.									
14		.	.									
15		.	.									
16		.	.									
17		.	.									
18		.	.									
19		.	.									
20		.	.									

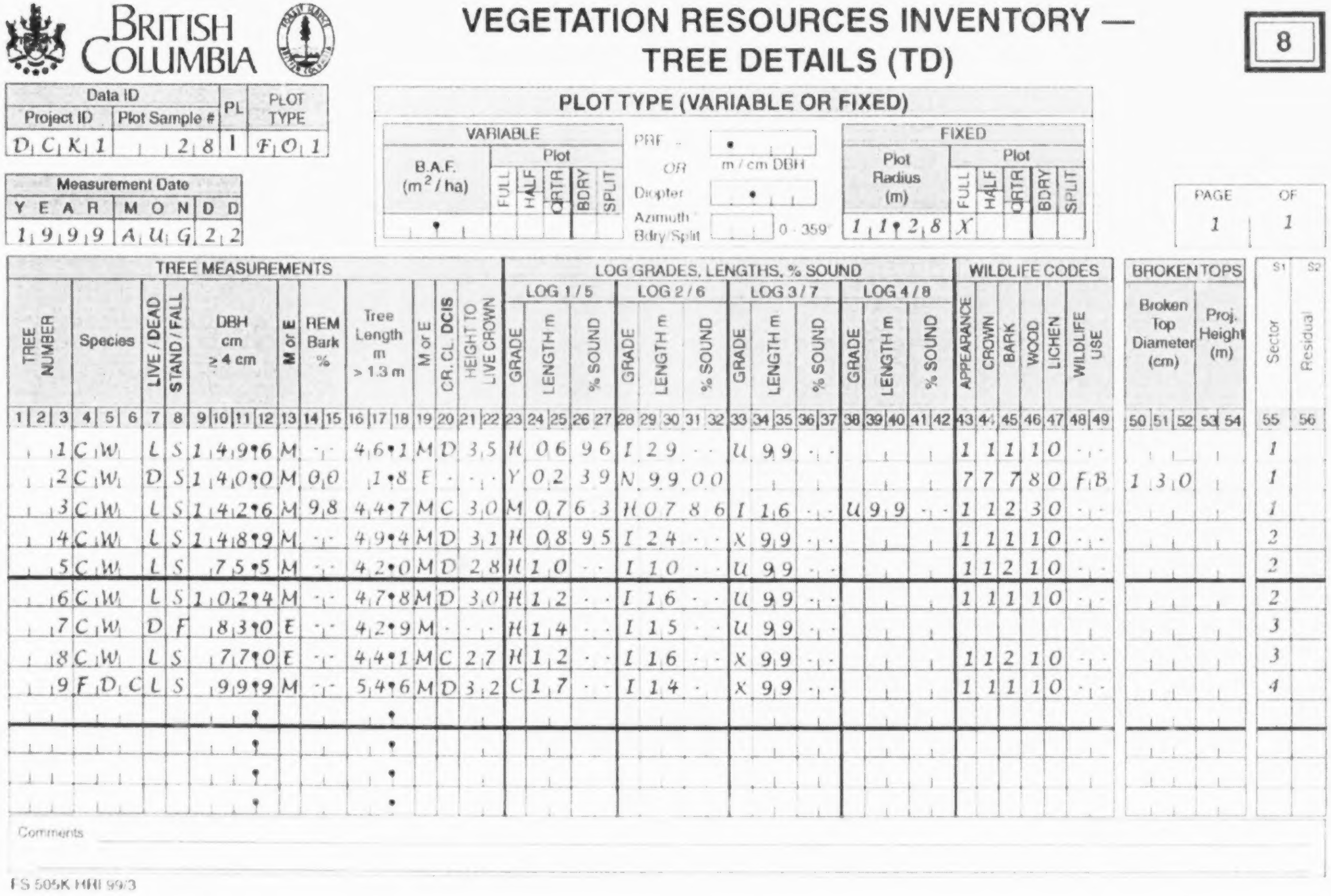
FS 505P HRI 99/3

TRANSECT 2
ACCUMULATION AND/OR ODD-SHAPED PIECES

No.	Species	ON TRANSECT Horizontal Length (cm)	ON TRANSECT Vertical Depth (cm)	Length (m)	Transect % Decay Class 1	Transect Class Other	(X) Merch	(X) P/R	Decay Class for Piece	S4
24 25	26 27 28	29 30 31	32 33 34	35 36 37	38 39	40	41	42	43	44
21				.						
22				.						
23				.						
24				.						
25				.						
26				.						
27				.						
28				.						
29				.						
30				.						

Comments

Figure A.9 — Sample field card 7: Coarse Woody Debris (EC) (Transect 2)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — TREE DETAILS (TD)

8

Data ID			
Project ID	Plot Sample #	PL	PLOT TYPE
DCK1	28	1	F01

Measurement Date		
YEAR	MON	DD
1999	AUG	22

PLOT TYPE (VARIABLE OR FIXED)

VARIABLE							FIXED					
B.A.F. (m^2/ha)	Plot						Plot Radius (m)	Plot				
	FULL	HALF	QRTR	BDRY	SPLIT			FULL	HALF	QRTR	BDRY	SPLIT
.							11.28	X				

PRF – . m / cm DBH
OR
Diopter .
Azimuth Bdry/Split 0 - 359°

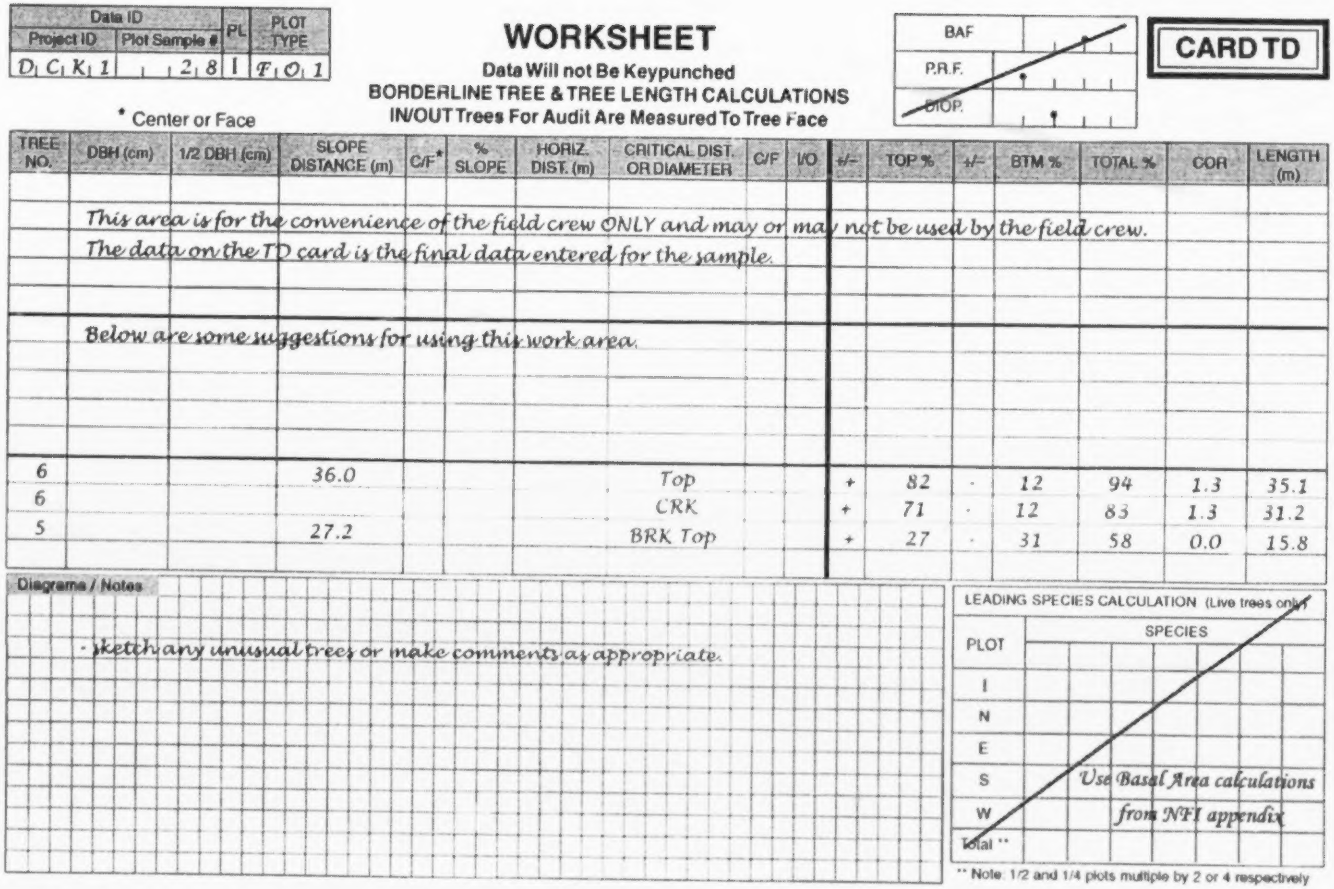
PAGE 1 OF 1

TREE MEASUREMENTS											LOG GRADES, LENGTHS, % SOUND												WILDLIFE CODES						BROKEN TOPS		S1	S2
											LOG 1/5			LOG 2/6			LOG 3/7			LOG 4/8												
TREE NUMBER	Species	LIVE / DEAD	STAND / FALL	DBH cm ≥ 4 cm	M or E	REM Bark %	Tree Length m > 1.3 m	M or E	CR. CL. DCIS	HEIGHT TO LIVE CROWN	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	GRADE	LENGTH m	% SOUND	APPEARANCE	CROWN	BARK	WOOD	LICHEN	WILDLIFE USE	Broken Top Diameter (cm)	Proj. Height (m)	Sector	Residual
1 2 3	4 5 6	7	8	9 10 11 12	13	14 15	16 17 18	19	20	21 22	23	24 25	26 27	28	29 30	31 32	33	34 35	36 37	38	39 40	41 42	43	44	45	46	47	48 49	50 51 52	53 54	55	56
1	CW	L	S	149.6	M		46.1	M	D	3.5	H	06	96	I	29		U	99					1	1	1	1	0				1	
2	CW	D	S	140.0	M	00	1.8	E			Y	02	39	N	99	00							7	7	7	8	0	FB	130		1	
3	CW	L	S	142.6	M	98	44.7	M	C	3.0	M	07	63	H	07	86	I	16		U	99		1	1	2	3	0				1	
4	CW	L	S	148.9	M		49.4	M	D	3.1	H	08	95	I	24		X	99					1	1	1	1	0				2	
5	CW	L	S	75.5	M		42.0	M	D	2.8	H	10		I	10		U	99					1	1	2	1	0				2	
6	CW	L	S	102.4	M		47.8	M	D	3.0	H	12		I	16		U	99					1	1	1	1	0				2	
7	CW	D	F	83.0	E		42.9	M			H	14		I	15		U	99													3	
8	CW	L	S	77.0	E		44.1	M	C	2.7	H	12		I	16		X	99					1	1	2	1	0				3	
9	FDC	L	S	99.9	M		54.6	M	D	3.2	C	17		I	14		X	99					1	1	1	1	0				4	
				.			.																									
				.			.																									
				.			.																									
				.			.																									
				.			.																									

Comments

FS 505K HRI 99/3

Figure A.10 — Sample field card 8: Tree Details (TD) (front)



Data ID			
Project ID	Plot Sample #	PL	PLOT TYPE
D C K 1	2 8	I	F O 1

* Center or Face

WORKSHEET

Data Will not Be Keypunched

BORDERLINE TREE & TREE LENGTH CALCULATIONS

IN/OUT Trees For Audit Are Measured To Tree Face

CARD TD

BAF	
P.R.F.	
DIOP.	

This area is for the convenience of the field crew ONLY and may or may not be used by the field crew.

The data on the TD card is the final data entered for the sample.

Below are some suggestions for using this work area.

TREE NO.	DBH (cm)	1/2 DBH (cm)	SLOPE DISTANCE (m)	C/F*	% SLOPE	HORIZ. DIST. (m)	CRITICAL DIST. OR DIAMETER	C/F	I/O	+/-	TOP %	+/-	BTM %	TOTAL %	COR	LENGTH (m)
6			36.0				Top			+	82	-	12	94	1.3	35.1
6							CRK			+	71	-	12	83	1.3	31.2
5			27.2				BRK Top			+	27	-	31	58	0.0	15.8

Diagrams / Notes

- sketch any unusual trees or make comments as appropriate.

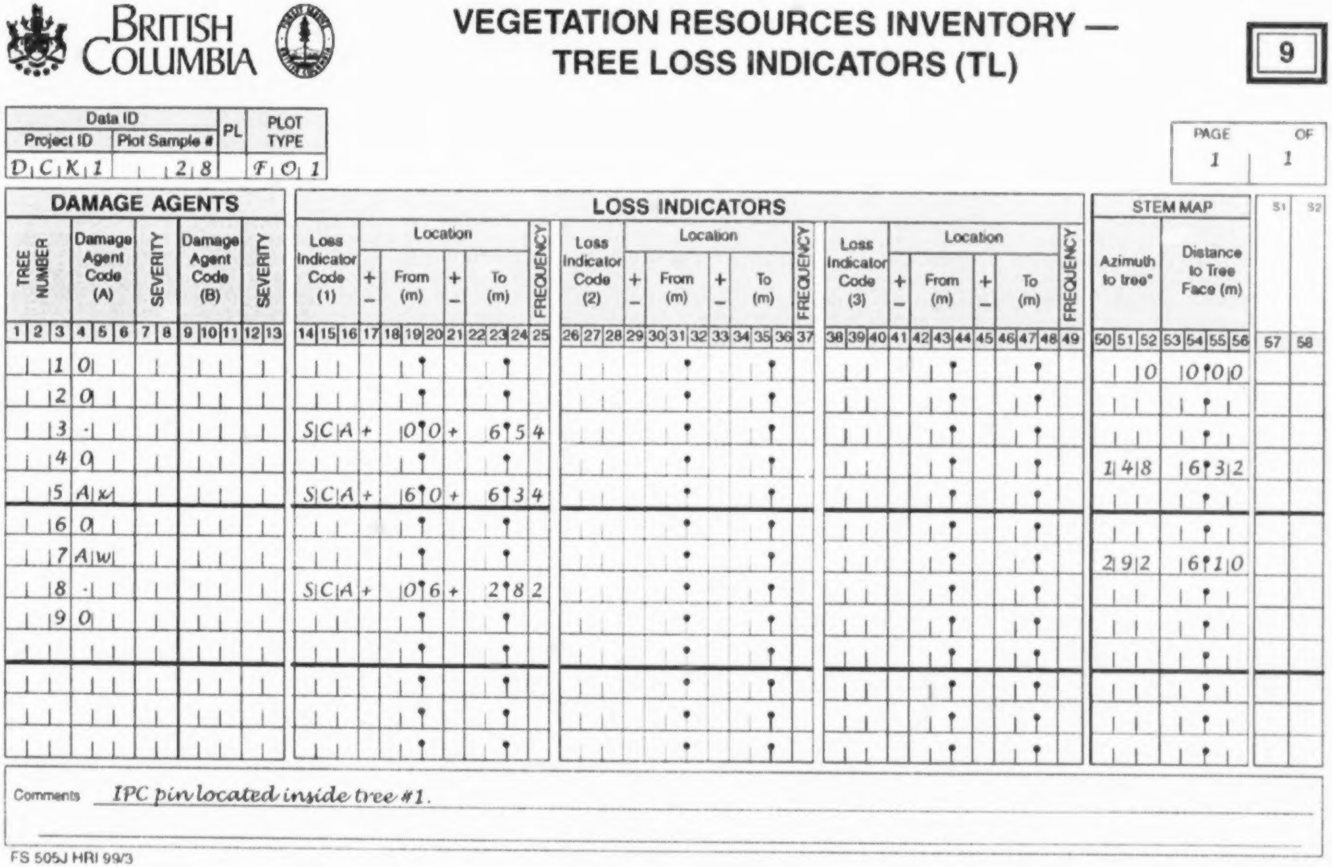
LEADING SPECIES CALCULATION (Live trees only)

PLOT	SPECIES						
I							
N							
E							
S							
W							
Total **							

Use Basal Area calculations from NFI appendix

** Note: 1/2 and 1/4 plots multiple by 2 or 4 respectively

Figure A.11 — Sample field card 8: Tree Details (TD) (reverse).



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — TREE LOSS INDICATORS (TL)

9

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
DCK1	28		FO1

PAGE 1 OF 1

DAMAGE AGENTS					LOSS INDICATORS																		STEM MAP		S1	S2
TREE NUMBER	Damage Agent Code (A)	SEVERITY	Damage Agent Code (B)	SEVERITY	Loss Indicator Code (1)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	Loss Indicator Code (2)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	Loss Indicator Code (3)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	Azimuth to tree°	Distance to Tree Face (m)		
1 2 3	4 5 6	7 8	9 10 11	12 13	14 15 16	17	18 19 20	21	22 23 24	25	26 27 28	29	30 31 32	33	34 35 36	37	38 39 40	41	42 43 44	45	46 47 48	49	50 51 52	53 54 55 56	57	58
1	O						.		.				.		.				.		.		0	0.00		
2	O						.		.				.		.				.		.			.		
3	-				SCA	+	0.0	+	6.5	4			.		.				.		.			.		
4	O						.		.				.		.				.		.		148	6.32		
5	AX				SCA	+	6.0	+	6.3	4			.		.				.		.			.		
6	O						.		.				.		.				.		.			.		
7	AW						.		.				.		.				.		.		292	6.10		
8	-				SCA	+	0.6	+	2.8	2			.		.				.		.			.		
9	O						.		.				.		.				.		.			.		
							.		.				.		.				.		.			.		
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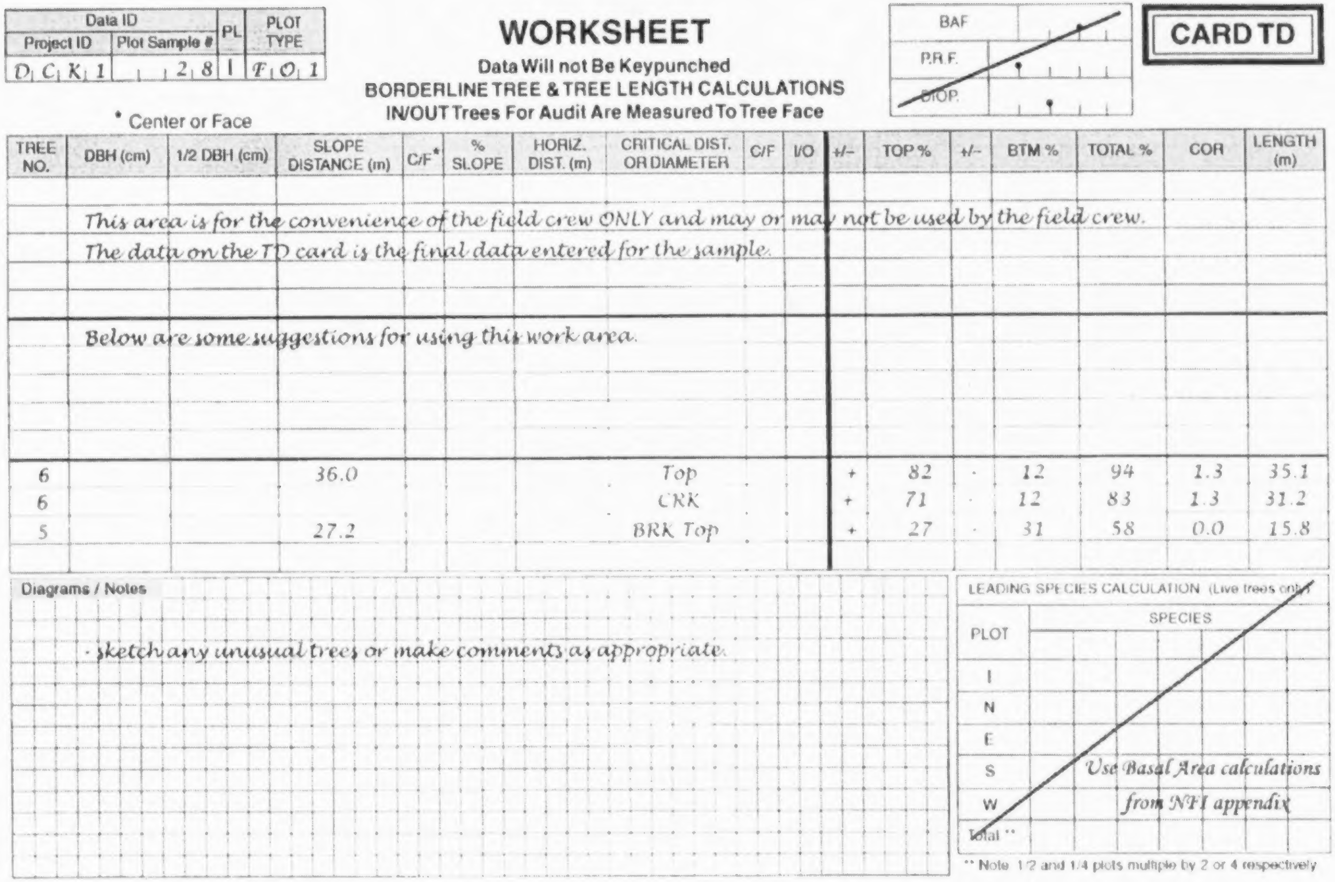
							.		.				.		.				.		.			.		

Comments IPC pin located inside tree #1.

FS 505J HRI 99/3

Figure A.12 — Sample field card 9: Tree Loss Indicators (TL)



Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

WORKSHEET

Data Will not Be Keypunched

BORDERLINE TREE & TREE LENGTH CALCULATIONS

IN/OUT Trees For Audit Are Measured To Tree Face

* Center or Face

BAF	
P.R.F.	
DIOP.	

CARD TD

TREE NO.	DBH (cm)	1/2 DBH (cm)	SLOPE DISTANCE (m)	C/F*	% SLOPE	HORIZ. DIST. (m)	CRITICAL DIST. OR DIAMETER	C/F	I/O	+/-	TOP %	+/-	BTM %	TOTAL %	COR	LENGTH (m)
	This area is for the convenience of the field crew ONLY and may or may not be used by the field crew.															
	The data on the TD card is the final data entered for the sample.															
	Below are some suggestions for using this work area.															
6			36.0				Top			+	82	-	12	94	1.3	35.1
6							CRK			+	71	-	12	83	1.3	31.2
5			27.2				BRK Top			+	27	-	31	58	0.0	15.8

Diagrams / Notes

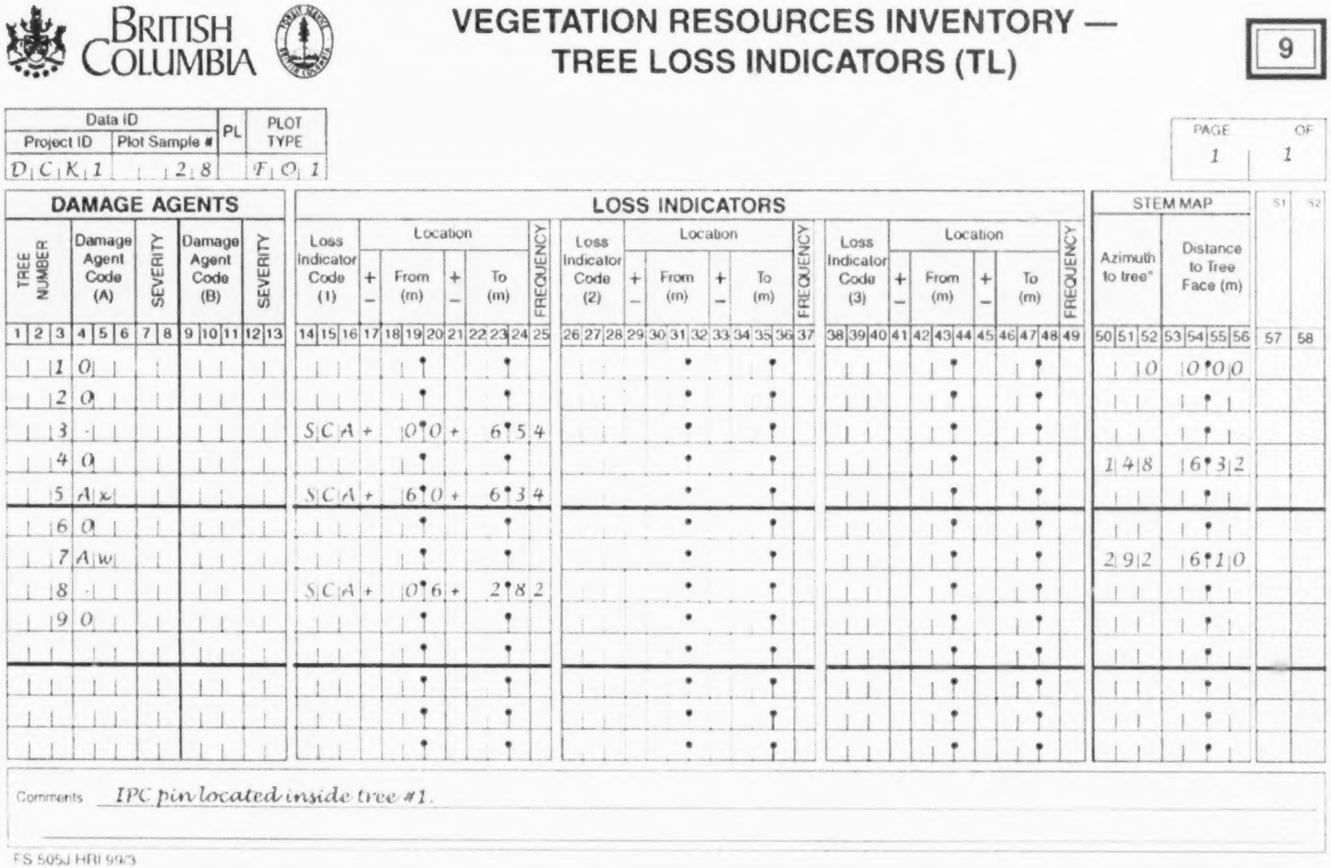
- sketch any unusual trees or make comments as appropriate.

LEADING SPECIES CALCULATION (Live trees only)

PLOT	SPECIES					
I						
N						
E						
S	Use Basal Area calculations					
W	from NFI appendix					
Total **						

** Note 1/2 and 1/4 plots multiple by 2 or 4 respectively

Figure A.11 — Sample field card 8: Tree Details (TD) (reverse).



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — TREE LOSS INDICATORS (TL)

9

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE
DCK1	28		FO1

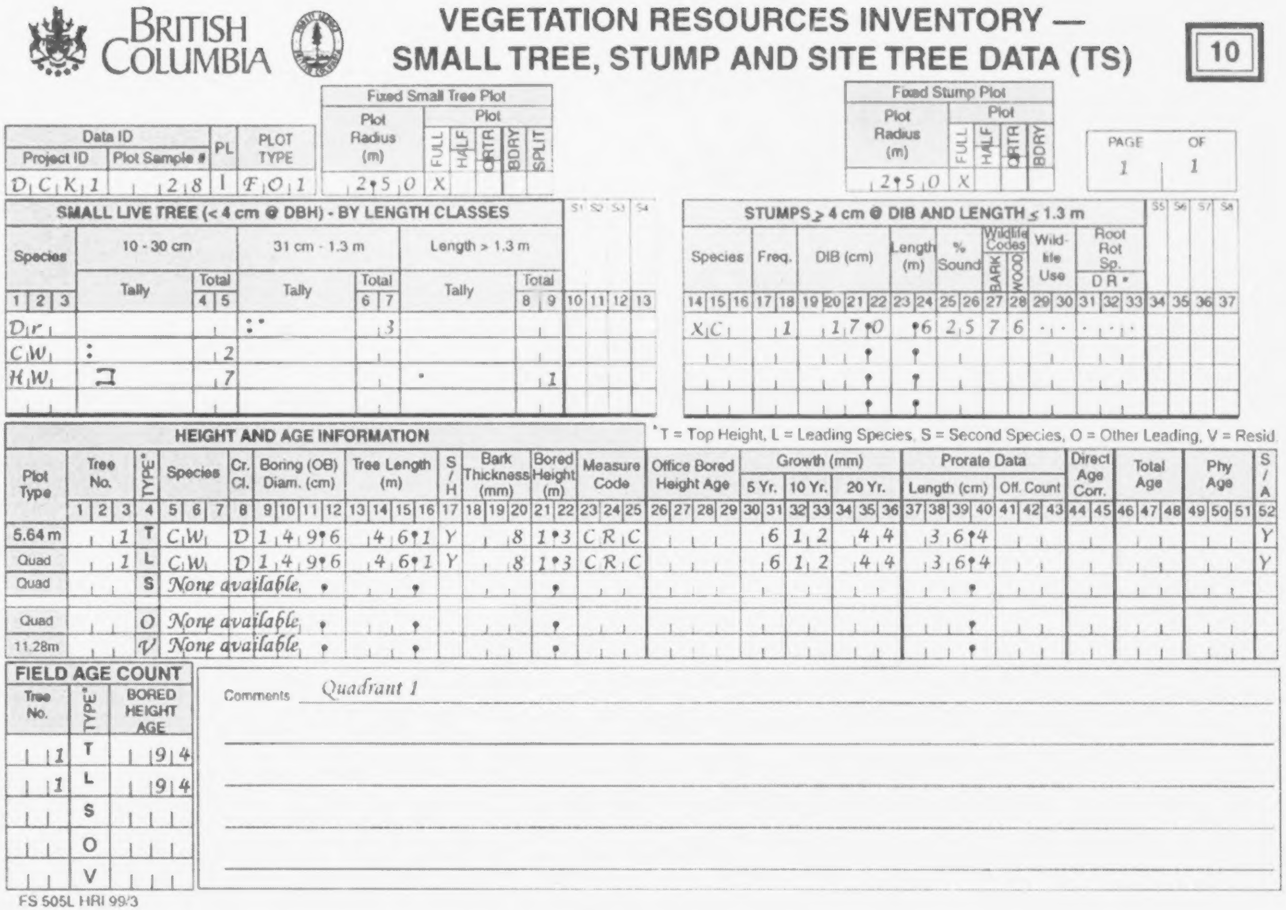
PAGE	OF
1	1

DAMAGE AGENTS: TREE NUMBER	Damage Agent Code (A)	SEVERITY	Damage Agent Code (B)	SEVERITY	LOSS INDICATORS: Loss Indicator Code (1)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	Loss Indicator Code (2)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	Loss Indicator Code (3)	+ –	Location From (m)	+ –	Location To (m)	FREQUENCY	STEM MAP: Azimuth to tree°	STEM MAP: Distance to Tree Face (m)	S1	S2
1 2 3	4 5 6	7 8	9 10 11	12 13	14 15 16	17	18 19 20	21	22 23 24	25	26 27 28	29	30 31 32	33	34 35 36	37	38 39 40	41	42 43 44	45	46 47 48	49	50 51 52	53 54 55 56	57	58
1	0																						0	0.00		
2	0																									
3	-				SCA	+	0.0	+	6.5	4																
4	0																						148	6.32		
5	Ax				SCA	+	6.0	+	6.3	4																
6	0																									
7	Aw																						292	6.10		
8	-				SCA	+	0.6	+	2.8	2																
9	0																									

Comments IPC pin located inside tree #1.

FS 505J HRI 99/3

Figure A.12 — Sample field card 9: Tree Loss Indicators (TL)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — SMALL TREE, STUMP AND SITE TREE DATA (TS)

10

Data ID Project ID	Data ID Plot Sample #	PL	PLOT TYPE	Fixed Small Tree Plot Plot Radius (m)	FULL	HALF	QRTR	BDRY	SPLIT
DCK1	28	I	FO1	2•50	X				

Fixed Stump Plot Plot Radius (m)	FULL	HALF	QRTR	BDRY
2•50	X			

PAGE 1 OF 1

SMALL LIVE TREE (< 4 cm @ DBH) - BY LENGTH CLASSES

Species 1 2 3	10 - 30 cm Tally	10 - 30 cm Total 4 5	31 cm - 1.3 m Tally	31 cm - 1.3 m Total 6 7	Length > 1.3 m Tally	Length > 1.3 m Total 8 9	S1 10	S2 11	S3 12	S4 13
Dr			⁖	3						
CW	:	2								
HW	⊐	7			·	1				

STUMPS ≥ 4 cm @ DIB AND LENGTH ≤ 1.3 m

Species 14 15 16	Freq. 17 18	DIB (cm) 19 20 21 22	Length (m) 23 24	% Sound 25 26	Wildlife Codes BARK 27	Wildlife Codes WOOD 28	Wild-life Use 29 30	Root Rot Sp. D R * 31 32 33	S5 34	S6 35	S7 36	S8 37
XC	1	17•0	•6	25	7	6	· ·	· · ·				
		•	•									
		•	•									
		•	•									

HEIGHT AND AGE INFORMATION

*T = Top Height, L = Leading Species, S = Second Species, O = Other Leading, V = Resid

Plot Type	Tree No. 1 2 3	TYPE* 4	Species 5 6 7	Cr. Cl. 8	Boring (OB) Diam. (cm) 9 10 11 12	Tree Length (m) 13 14 15 16	S / H 17	Bark Thickness (mm) 18 19 20	Bored Height (m) 21 22	Measure Code 23 24 25	Office Bored Height Age 26 27 28 29	Growth (mm) 5 Yr. 30 31	Growth (mm) 10 Yr. 32 33	Growth (mm) 20 Yr. 34 35 36	Prorate Data Length (cm) 37 38 39 40	Prorate Data Off. Count 41 42 43	Direct Age Corr. 44 45	Total Age 46 47 48	Phy Age 49 50 51	S / A 52
5.64 m	1	T	CW	D	149•6	46•1	Y	8	1•3	CRC		6	12	44	36•4					Y
Quad	1	L	CW	D	149•6	46•1	Y	8	1•3	CRC		6	12	44	36•4					Y
Quad		S	None available		•	•			•						•					
Quad		O	None available		•	•			•						•					
11.28m		V	None available		•	•			•						•					

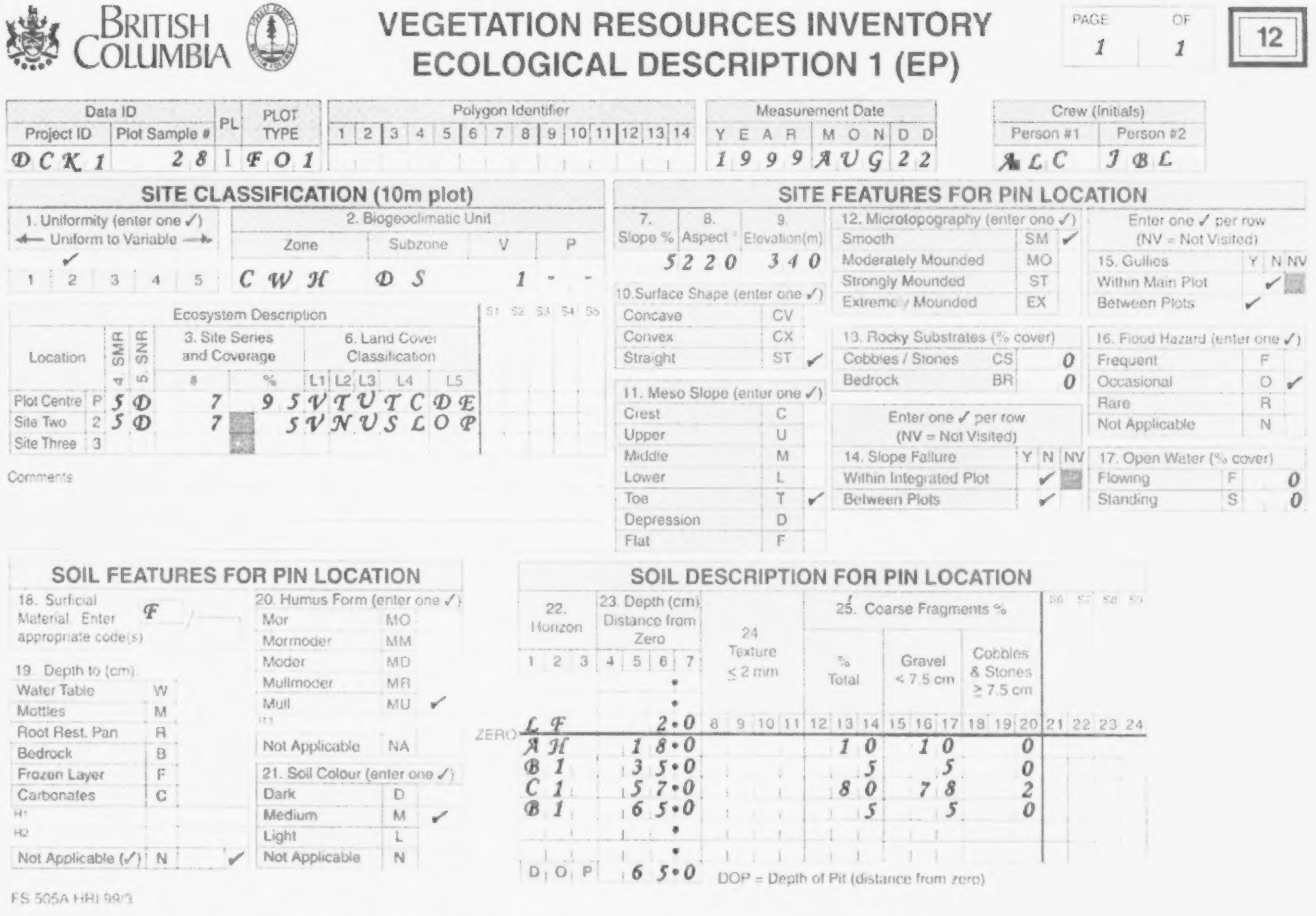
FIELD AGE COUNT

Tree No.	TYPE*	BORED HEIGHT AGE
1	T	94
1	L	94
	S	
	O	
	V	

Comments Quadrant 1

FS 505L HRI 99/3

Figure A.13 — Sample field card 10: Small Tree, Stump, and Site Tree Data (TS)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
ECOLOGICAL DESCRIPTION 1 (EP)

PAGE 1 OF 1 — 12

Project ID	Plot Sample #	PL	PLOT TYPE	Polygon Identifier (1–14)	Measurement Date (YEAR MON DD)	Crew (Initials) Person #1	Person #2
DCK1	28	I	FO1		1999 AUG 22	ALC	JBL

SITE CLASSIFICATION (10m plot)

1. Uniformity (enter one ✓) ← Uniform to Variable →

1	2	3	4	5
	✓			

2. Biogeoclimatic Unit

Zone	Subzone	V	P
CWH	DS	1	- -

Ecosystem Description

Location		4. SMR	5. SNR	3. Site Series and Coverage #	%	6. Land Cover Classification L1	L2	L3	L4	L5	S1	S2	S3	S4	S5
Plot Centre	P	5	D	7	95	V	T	U	TC	DE					
Site Two	2	5	D	7	5	V	N	U	SL	OP					
Site Three	3														

Comments

SITE FEATURES FOR PIN LOCATION

7. Slope %	8. Aspect	9. Elevation(m)
5	220	340

10. Surface Shape (enter one ✓)		
Concave	CV	
Convex	CX	
Straight	ST	✓

11. Meso Slope (enter one ✓)		
Crest	C	
Upper	U	
Middle	M	
Lower	L	
Toe	T	✓
Depression	D	
Flat	F	

12. Microtopography (enter one ✓)		
Smooth	SM	✓
Moderately Mounded	MO	
Strongly Mounded	ST	
Extreme / Mounded	EX	

13. Rocky Substrates (% cover)		
Cobbles / Stones	CS	0
Bedrock	BR	0

Enter one ✓ per row (NV = Not Visited)

14. Slope Failure	Y	N	NV
Within Integrated Plot		✓	▨
Between Plots		✓	

Enter one ✓ per row (NV = Not Visited)

15. Gullies	Y	N	NV
Within Main Plot		✓	▨
Between Plots		✓	

16. Flood Hazard (enter one ✓)		
Frequent	F	
Occasional	O	✓
Rare	R	
Not Applicable	N	

17. Open Water (% cover)		
Flowing	F	0
Standing	S	0

SOIL FEATURES FOR PIN LOCATION

18. Surficial Material. Enter appropriate code(s): F

19. Depth to (cm)		
Water Table	W	
Mottles	M	
Root Rest. Pan	R	
Bedrock	B	
Frozen Layer	F	
Carbonates	C	
H1		
H2		
Not Applicable (✓)	N	✓

20. Humus Form (enter one ✓)		
Mor	MO	
Mormoder	MM	
Moder	MD	
Mullmoder	MR	
Mull	MU	✓
H1		
Not Applicable	NA	

21. Soil Colour (enter one ✓)		
Dark	D	
Medium	M	✓
Light	L	
Not Applicable	N	

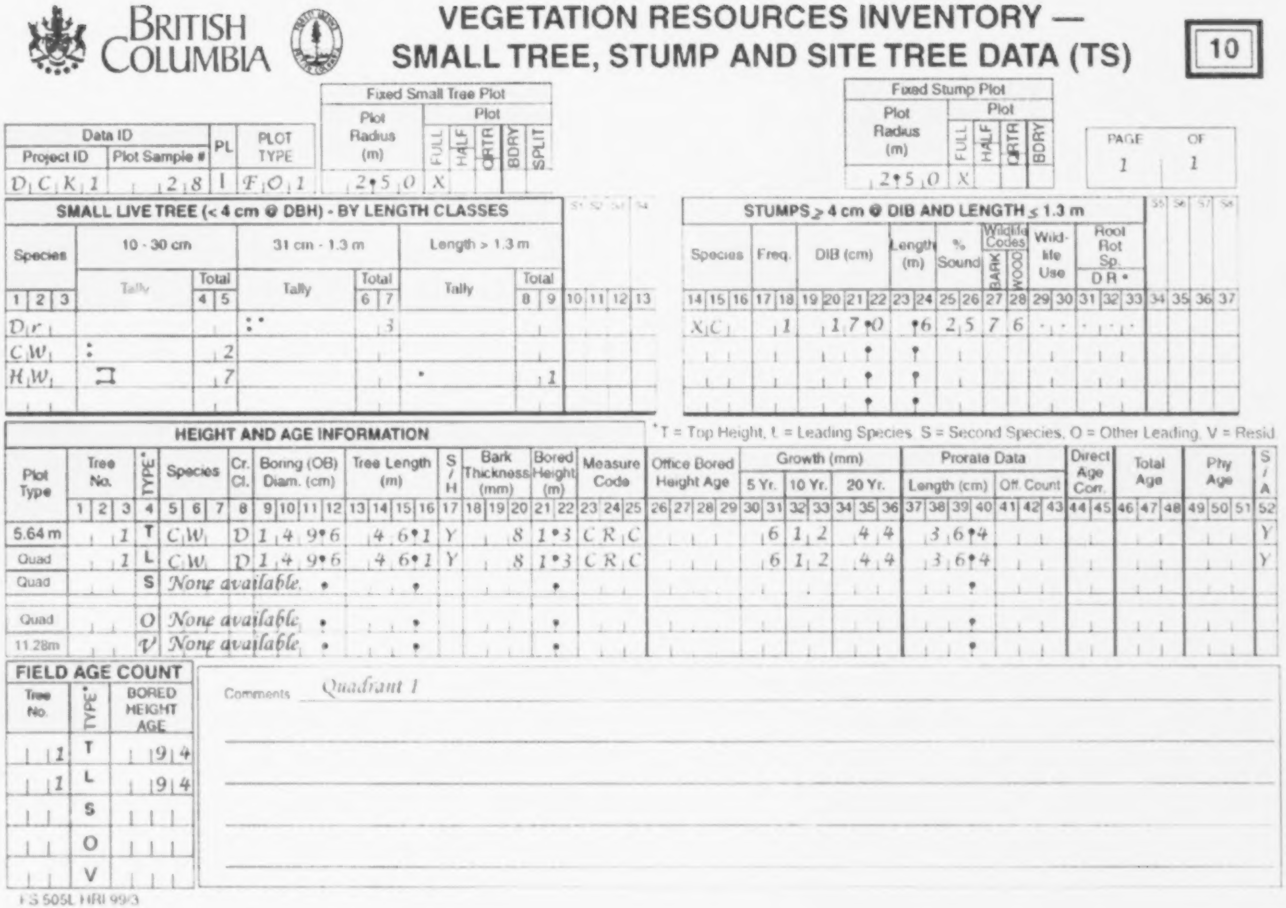
SOIL DESCRIPTION FOR PIN LOCATION

22. Horizon (1–3)	23. Depth (cm) Distance from Zero (4–7)	24 Texture ≤ 2 mm (8–11)	25. Coarse Fragments % Total (12–14)	Gravel < 7.5 cm (15–17)	Cobbles & Stones ≥ 7.5 cm (18–20)	S6 S7 S8 S9 (21–24)
LF	2.0					
ZERO						
AH	18.0		10	10	0	
B1	35.0		5	5	0	
C1	57.0		80	78	2	
B1	65.0		5	5	0	
DOP	65.0					

DOP = Depth of Pit (distance from zero)

FS 505A HRI 99/3

Figure A.14 — Sample field card 12: Ecological Description 1 (EP) (front)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY —
SMALL TREE, STUMP AND SITE TREE DATA (TS)

10

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE	Fixed Small Tree Plot: Plot Radius (m)	Plot: FULL	HALF	QRTR	BDRY	SPLIT
D C K 1	2 8	1	F O 1	2•5 0	X				

Fixed Stump Plot: Plot Radius (m)	Plot: FULL	HALF	QRTR	BDRY
2•5 0	X			

PAGE	OF
1	1

SMALL LIVE TREE (< 4 cm @ DBH) - BY LENGTH CLASSES

Species	10 - 30 cm Tally	Total	31 cm - 1.3 m Tally	Total	Length > 1.3 m Tally	Total	51	52	53	54
1 2 3		4 5		6 7		8 9	10	11	12	13
D r			⁚·	3						
C W	:	2								
H W	⊐	7			·	1				

STUMPS ≥ 4 cm @ DIB AND LENGTH ≤ 1.3 m

Species	Freq.	DIB (cm)	Length (m)	% Sound	Wildlife Codes: BARK	Wildlife Codes: WOOD	Wild-life Use	Root Rot Sp. D R •	55	56	57	58
14 15 16	17 18	19 20 21 22	23 24	25 26	27	28	29 30	31 32 33	34	35	36	37
X C	1	1 7•0	•6	2 5	7	6	· ·	· · ·				
		•	•									
		•	•									
		•	•									

HEIGHT AND AGE INFORMATION

*T = Top Height, L = Leading Species S = Second Species, O = Other Leading, V = Resid

Plot Type	Tree No.	TYPE*	Species	Cr. Cl.	Boring (OB) Diam. (cm)	Tree Length (m)	S / H	Bark Thickness (mm)	Bored Height (m)	Measure Code	Office Bored Height Age	Growth (mm): 5 Yr.	10 Yr.	20 Yr.	Prorate Data: Length (cm)	Off. Count	Direct Age Corr.	Total Age	Phy Age	S / A
	1 2 3	4	5 6 7	8	9 10 11 12	13 14 15 16	17	18 19 20	21 22	23 24 25	26 27 28 29	30 31	32 33	34 35 36	37 38 39 40	41 42 43	44 45	46 47 48	49 50 51	52
5.64 m	1	T	C W	D	1 4 9•6	4 6•1	Y	8	1•3	C R C		6	1 2	4 4	3 6•4					Y
Quad	1	L	C W	D	1 4 9•6	4 6•1	Y	8	1•3	C R C		6	1 2	4 4	3 6•4					Y
Quad		S	None available.		•	•			•						•					
Quad		O	None available		•	•			•						•					
11.28m		V	None available		•	•			•						•					

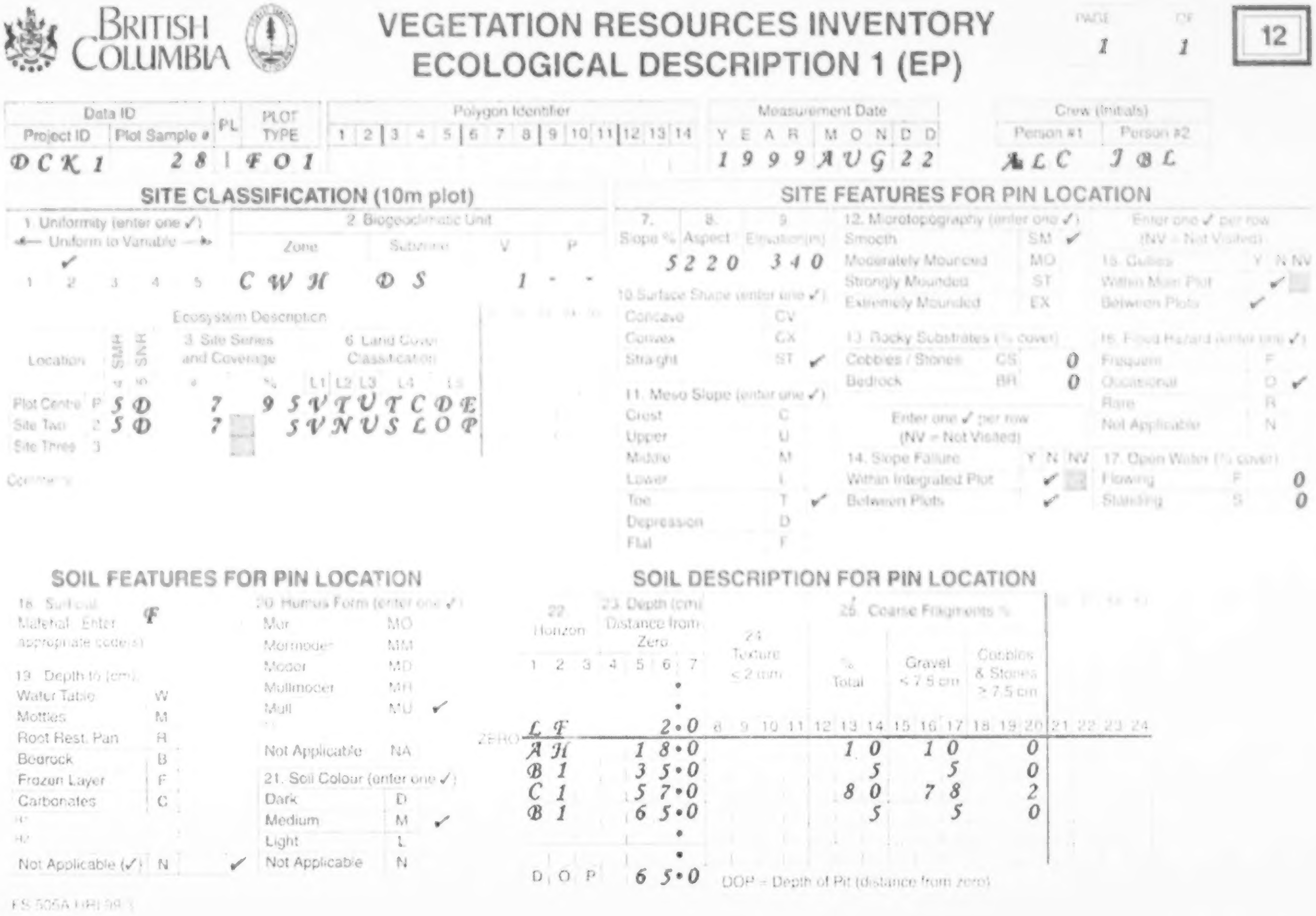
FIELD AGE COUNT

Tree No.	TYPE*	BORED HEIGHT AGE
1	T	9 4
1	L	9 4
	S	
	O	
	V	

Comments Quadrant 1

FS 505L HRI 99/3

Figure A.13 — Sample field card 10: Small Tree, Stump, and Site Tree Data (TS)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
ECOLOGICAL DESCRIPTION 1 (EP)

PAGE 1 OF 1

12

Project ID	Plot Sample #	PL	PLOT TYPE	Polygon Identifier	Measurement Date (YEAR MON DD)	Crew Person #1	Crew Person #2
DCK1	28	1	FO1		1999 AUG 22	ALC	JBL

SITE CLASSIFICATION (10m plot)

1. Uniformity (enter one ✓) ← Uniform to Variable →: 1 [✓ 2] 3 4 5

2. Biogeoclimatic Unit: Zone CWH; Subzone DS; V 1; P -

Ecosystem Description

Location		SMR	SNR	3. Site Series and Coverage #	%	6. Land Cover Classification L1 L2 L3 L4 L5
Plot Centre	P	5	D	7	9	5VTUTCDE
Site Two	2	5	D	7		5VNUSLOP
Site Three	3					

Comments

SITE FEATURES FOR PIN LOCATION

7. Slope %	8. Aspect	9. Elevation (m)
5	220	340

10. Surface Shape (enter one ✓)
- Concave CV
- Convex CX
- Straight ST ✓

11. Meso Slope (enter one ✓)
- Crest C
- Upper U
- Middle M
- Lower L
- Toe T ✓
- Depression D
- Flat F

12. Microtopography (enter one ✓)
- Smooth SM ✓
- Moderately Mounded MO
- Strongly Mounded ST
- Extremely Mounded EX

13. Rocky Substrates (% cover)
- Cobbles / Stones CS 0
- Bedrock BR 0

Enter one ✓ per row (NV = Not Visited)

14. Slope Failure	Y	N	NV
Within Integrated Plot		✓	
Between Plots		✓	

Enter one ✓ per row (NV = Not Visited)

15. Gullies	Y	N	NV
Within Main Plot		✓	
Between Plots	✓		

16. Flood Hazard (enter one ✓)
- Frequent F
- Occasional O ✓
- Rare R
- Not Applicable N

17. Open Water (% cover)
- Flowing F 0
- Standing S 0

SOIL FEATURES FOR PIN LOCATION

18. Surficial Material: Enter appropriate code(s): F

19. Depth to (cm):
- Water Table W
- Mottles M
- Root Rest. Pan R
- Bedrock B
- Frozen Layer F
- Carbonates C
- Not Applicable (✓) N ✓

20. Humus Form (enter one ✓)
- Mor MO
- Mormoder MM
- Moder MD
- Mullmoder MR
- Mull MU ✓
- Not Applicable NA

21. Soil Colour (enter one ✓)
- Dark D
- Medium M ✓
- Light L
- Not Applicable N

SOIL DESCRIPTION FOR PIN LOCATION

22. Horizon	23. Depth (cm) Distance from Zero	24. Texture ≤ 2 mm	25. Coarse Fragments % Total	Gravel < 7.5 cm	Cobbles & Stones ≥ 7.5 cm
LF	2.0				
ZERO					
AH	18.0		10	10	0
B1	35.0		5	5	0
C1	57.0		80	78	2
B1	65.0		5	5	0
DOP	65.0				

DOP = Depth of Pit (distance from zero)

FS 505A HRI 99/3

Figure A.14 — Sample field card 12: Ecological Description 1 (EP) (front)

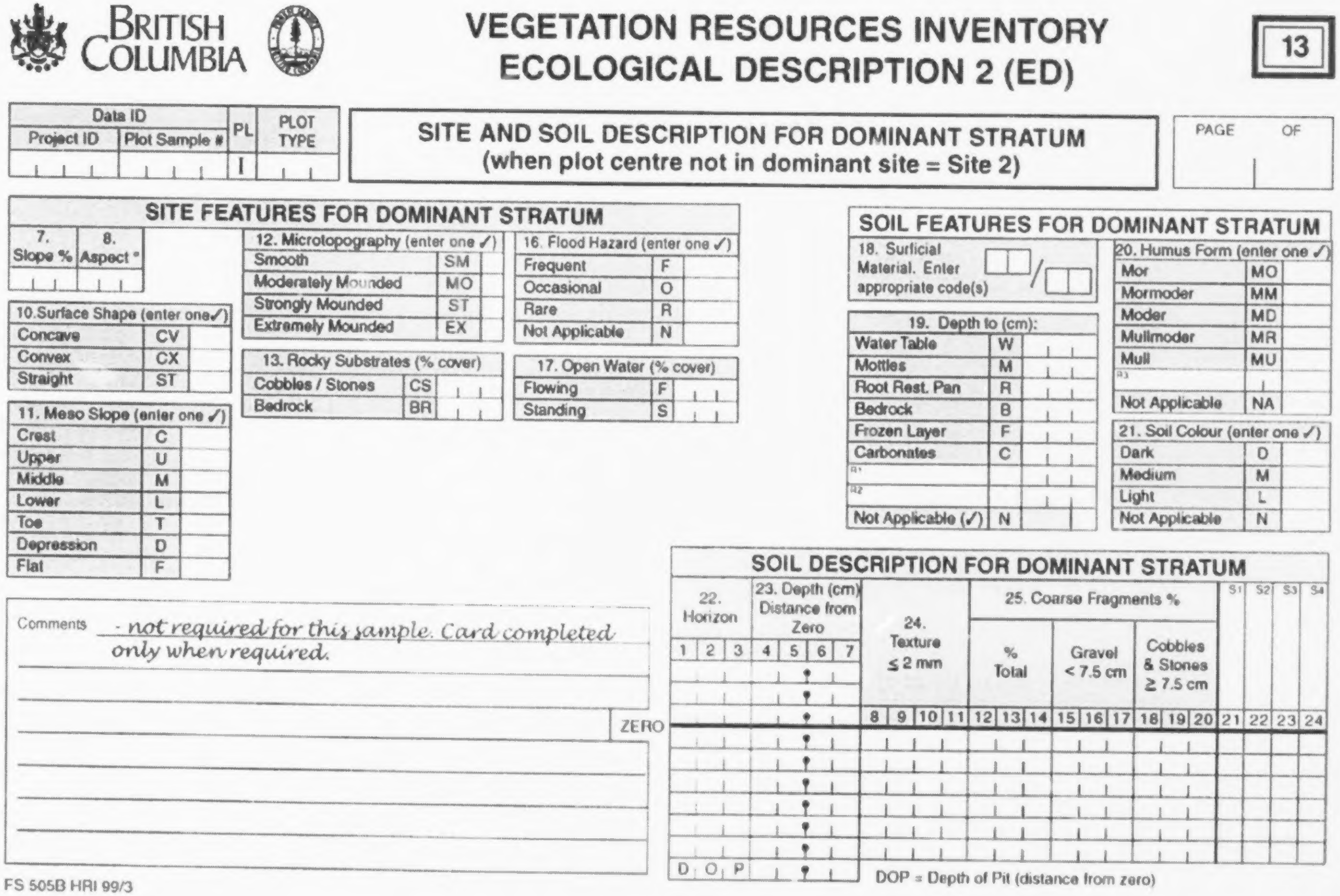
CARD EP

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	1	F O 1

Comments

- plot has minor periodic flooding from small creek adjacent to sample.
- IPC located on edge of toe slope.

Figure A.15 — Sample field card 12: Ecological Description 1 (EP) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY
ECOLOGICAL DESCRIPTION 2 (ED)

13

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
		I	

SITE AND SOIL DESCRIPTION FOR DOMINANT STRATUM
(when plot centre not in dominant site = Site 2)

PAGE OF

SITE FEATURES FOR DOMINANT STRATUM

7. Slope %	8. Aspect °

10.Surface Shape (enter one✓)		
Concave	CV	
Convex	CX	
Straight	ST	

11. Meso Slope (enter one ✓)		
Crest	C	
Upper	U	
Middle	M	
Lower	L	
Toe	T	
Depression	D	
Flat	F	

12. Microtopography (enter one ✓)		
Smooth	SM	
Moderately Mounded	MO	
Strongly Mounded	ST	
Extremely Mounded	EX	

13. Rocky Substrates (% cover)		
Cobbles / Stones	CS	
Bedrock	BR	

16. Flood Hazard (enter one ✓)		
Frequent	F	
Occasional	O	
Rare	R	
Not Applicable	N	

17. Open Water (% cover)		
Flowing	F	
Standing	S	

SOIL FEATURES FOR DOMINANT STRATUM

18. Surficial Material. Enter appropriate code(s) ☐☐/☐☐

19. Depth to (cm):		
Water Table	W	
Mottles	M	
Root Rest. Pan	R	
Bedrock	B	
Frozen Layer	F	
Carbonates	C	
R1		
R2		
Not Applicable (✓)	N	

20. Humus Form (enter one ✓)		
Mor	MO	
Mormoder	MM	
Moder	MD	
Mullmoder	MR	
Mull	MU	
R3		
Not Applicable	NA	

21. Soil Colour (enter one ✓)		
Dark	D	
Medium	M	
Light	L	
Not Applicable	N	

Comments - not required for this sample. Card completed only when required.

ZERO

SOIL DESCRIPTION FOR DOMINANT STRATUM

22. Horizon	23. Depth (cm) Distance from Zero	24. Texture ≤ 2 mm	25. Coarse Fragments %			S1	S2	S3	S4
			% Total	Gravel < 7.5 cm	Cobbles & Stones ≥ 7.5 cm				
1 2 3	4 5 6 7	8 9 10 11	12 13 14	15 16 17	18 19 20	21	22	23	24
D O P									

DOP = Depth of Pit (distance from zero)

FS 505B HRI 99/3

Figure A.16 — Sample field card 13: Ecological Description 2 (ED) (front)

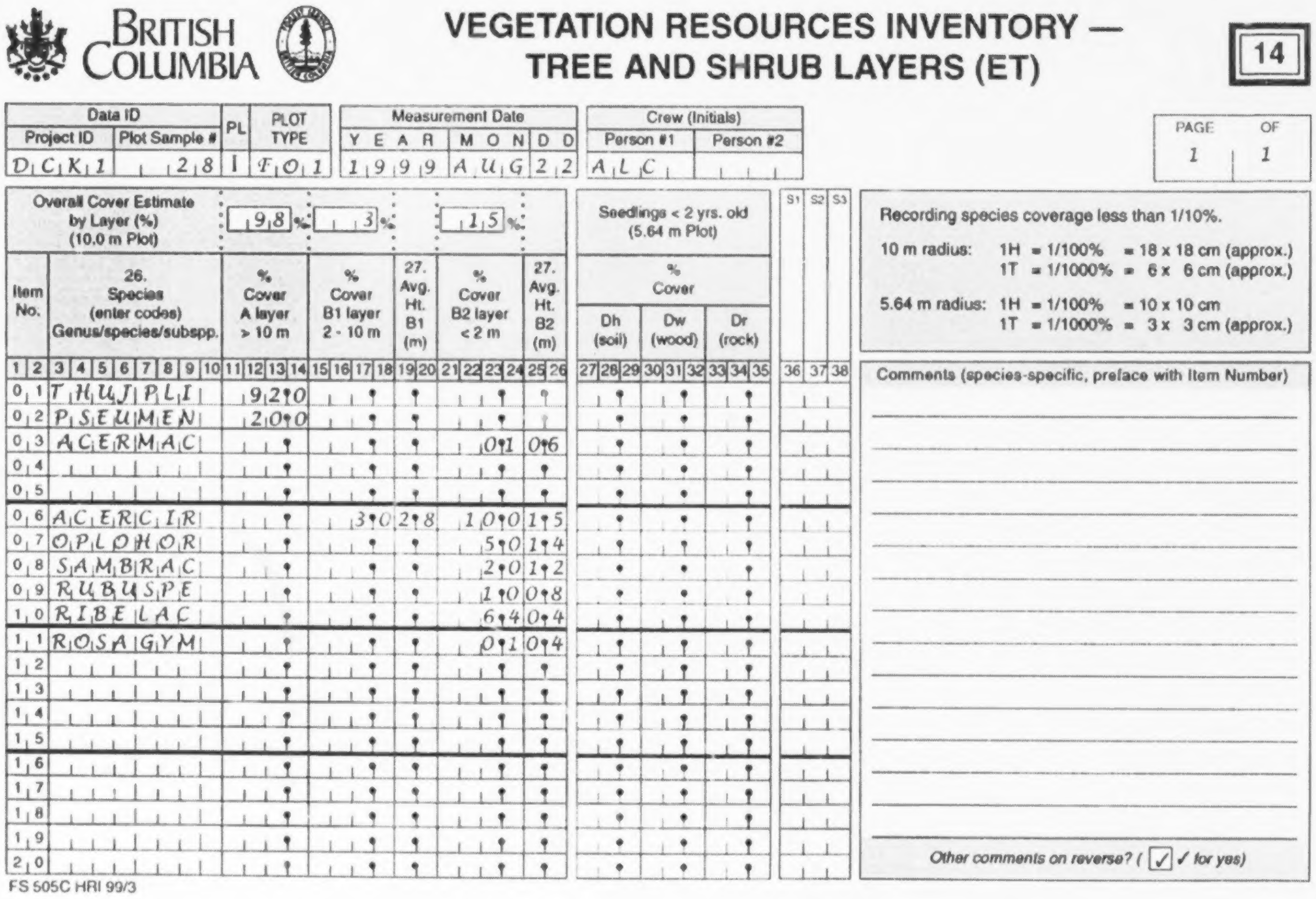
CARD ED

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
		I	

Comments

- no comment required for this sample.

Figure A.17 — Sample field card 13: Ecological Description 2 (ED) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — TREE AND SHRUB LAYERS (ET)

14

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE	Measurement Date: YEAR	MON	DD	Crew (Initials): Person #1	Person #2
DCK1	28	I	FO1	1999	AUG	22	ALC	

PAGE 1 OF 1

Overall Cover Estimate by Layer (%) (10.0 m Plot): 98 % | 3 % | 15 %

Item No.	26. Species (enter codes) Genus/species/subspp.	% Cover A layer > 10 m	% Cover B1 layer 2 - 10 m	27. Avg. Ht. B1 (m)	% Cover B2 layer < 2 m	27. Avg. Ht. B2 (m)	Seedlings < 2 yrs. old (5.64 m Plot) % Cover Dh (soil)	Dw (wood)	Dr (rock)	S1	S2	S3
1 2	3 4 5 6 7 8 9 10	11 12 13 14	15 16 17 18	19 20	21 22 23 24	25 26	27 28 29	30 31 32	33 34 35	36	37	38
01	THUJPLI	92.0										
02	PSEUMEN	20.0										
03	ACERMAC				0.1	0.6						
04												
05												
06	ACERCIR		3.0	2.8	10.0	1.5						
07	OPLOHOR				5.0	1.4						
08	SAMBRAC				2.0	1.2						
09	RUBUSPE				1.0	0.8						
10	RIBELAC				6.4	0.4						
11	ROSAGYM				0.1	0.4						
12												
13												
14												
15												
16												
17												
18												
19												
20												

Recording species coverage less than 1/10%.

10 m radius: 1H = 1/100% = 18 x 18 cm (approx.)
1T = 1/1000% = 6 x 6 cm (approx.)

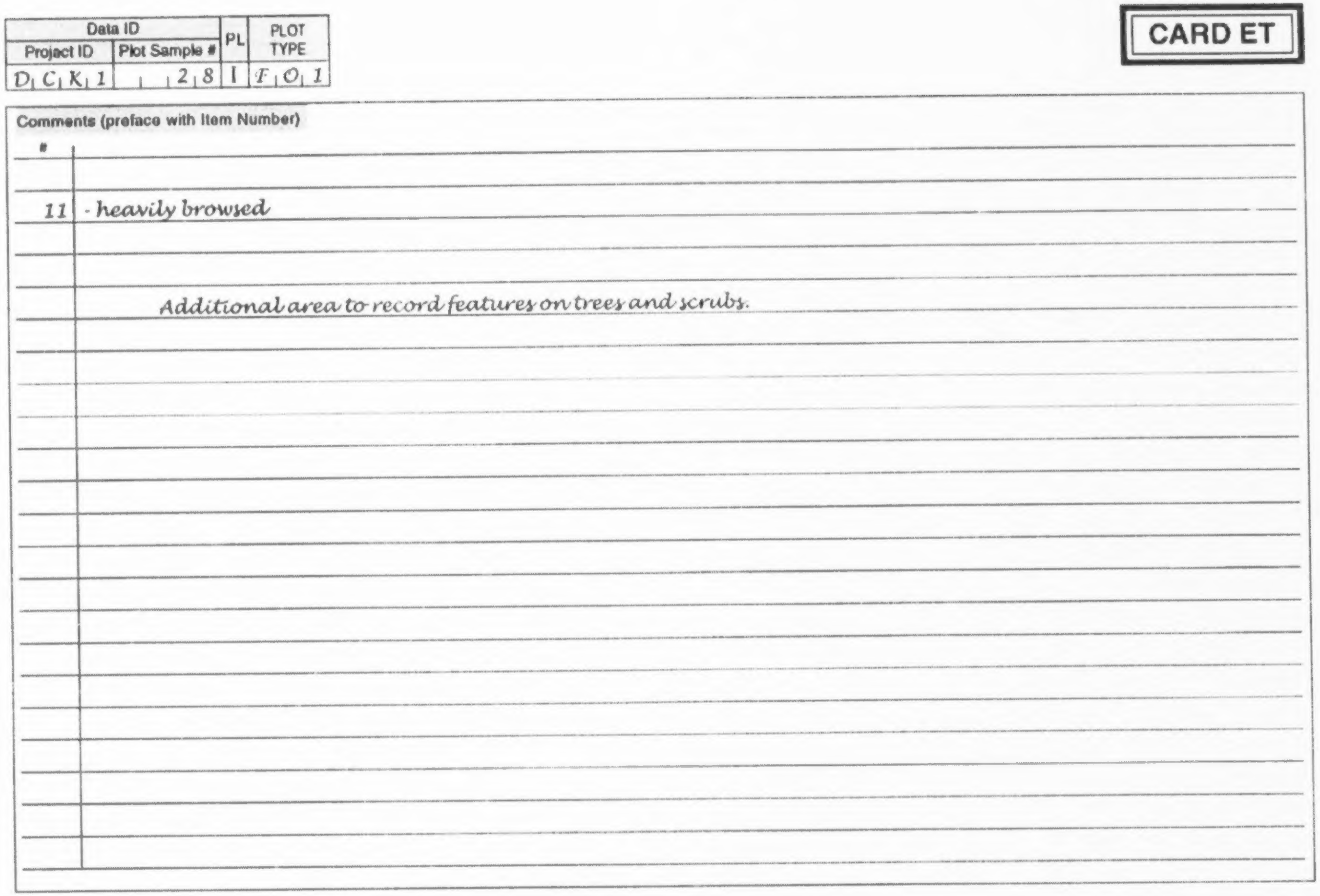
5.64 m radius: 1H = 1/100% = 10 x 10 cm
1T = 1/1000% = 3 x 3 cm (approx.)

Comments (species-specific, preface with Item Number)

Other comments on reverse? (☑ ✓ for yes)

FS 505C HRI 99/3

Figure A.18 — Sample field card 14: Tree and Shrub Layers (ET) (front)



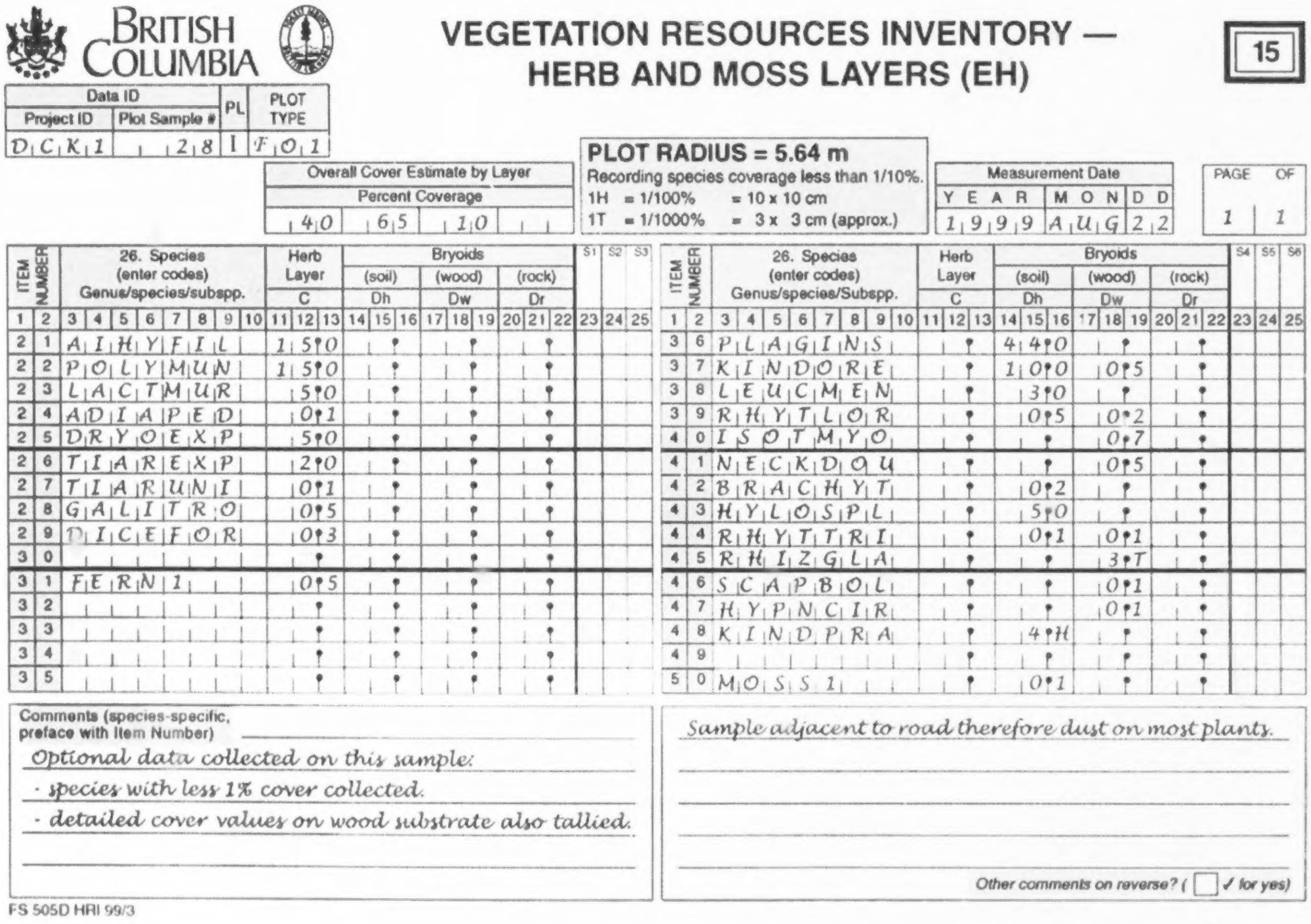
CARD ET

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	I	F O 1

Comments (preface with Item Number)

#	
11	- heavily browsed
	Additional area to record features on trees and scrubs.

Figure A.19 — Sample field card 14: Tree and Shrub Layers (ET) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY — HERB AND MOSS LAYERS (EH)

15

Data ID: Project ID	Data ID: Plot Sample #	PL	PLOT TYPE
DCK1	28	I	FO1

Overall Cover Estimate by Layer — Percent Coverage			
40	65	10	

PLOT RADIUS = 5.64 m

Recording species coverage less than 1/10%.

1H = 1/100% = 10 x 10 cm

1T = 1/1000% = 3 x 3 cm (approx.)

Measurement Date: YEAR	MON	DD	PAGE	OF
1999	AUG	22	1	1

ITEM NUMBER (1–2)	26. Species (enter codes) Genus/species/subspp. (3–10)	Herb Layer C (11–13)	Bryoids (soil) Dh (14–16)	Bryoids (wood) Dw (17–19)	Bryoids (rock) Dr (20–22)	S1 (23)	S2 (24)	S3 (25)
21	AIHYFIL	15.0						
22	POLYMUN	15.0						
23	LACTMUR	5.0						
24	ADIAPED	0.1						
25	DRYOEXP	5.0						
26	TIAREXP	2.0						
27	TIARUNI	0.1						
28	GALITRO	0.5						
29	DICEFOR	0.3						
30								
31	FERN1	0.5						
32								
33								
34								
35								

ITEM NUMBER (1–2)	26. Species (enter codes) Genus/species/Subspp. (3–10)	Herb Layer C (11–13)	Bryoids (soil) Dh (14–16)	Bryoids (wood) Dw (17–19)	Bryoids (rock) Dr (20–22)	S4 (23)	S5 (24)	S6 (25)
36	PLAGINS		44.0					
37	KINDORE		10.0	0.5				
38	LEUCMEN		3.0					
39	RHYTLOR		0.5	0.2				
40	ISOTMYO			0.7				
41	NECKDOU			0.5				
42	BRACHYT		0.2					
43	HYLOSPL		5.0					
44	RHYTTRI		0.1	0.1				
45	RHIZGLA			3.T				
46	SCAPBOL			0.1				
47	HYPNCIR			0.1				
48	KINDPRA		4.H					
49								
50	MOSS1		0.1					

Comments (species-specific, preface with Item Number)

Optional data collected on this sample:

- species with less 1% cover collected.

- detailed cover values on wood substrate also tallied.

Sample adjacent to road therefore dust on most plants.

Other comments on reverse? (☐ ✓ for yes)

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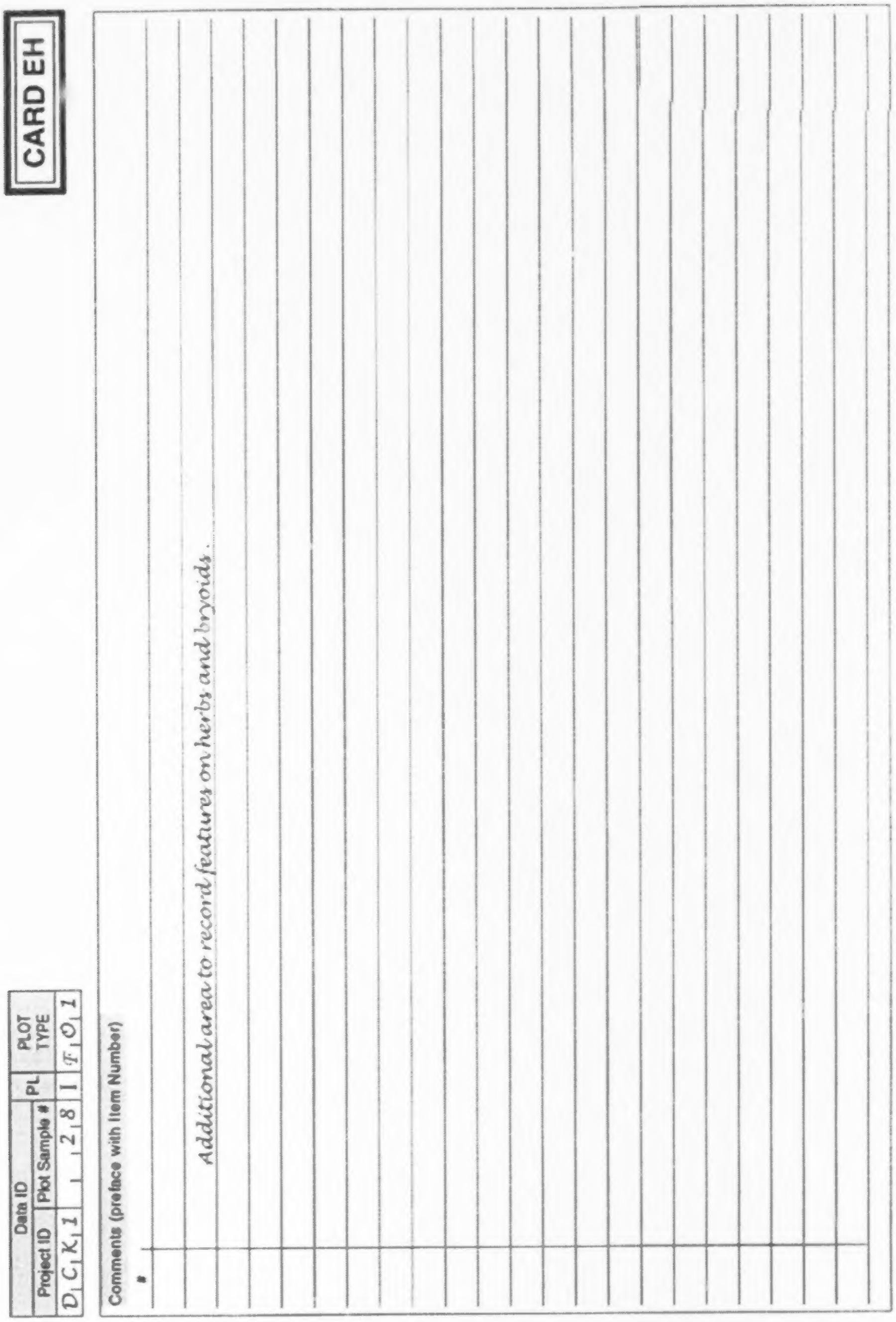
Figure A.20 — Sample field card 15: Herb and Moss Layers (EH) (front)



CARD EH

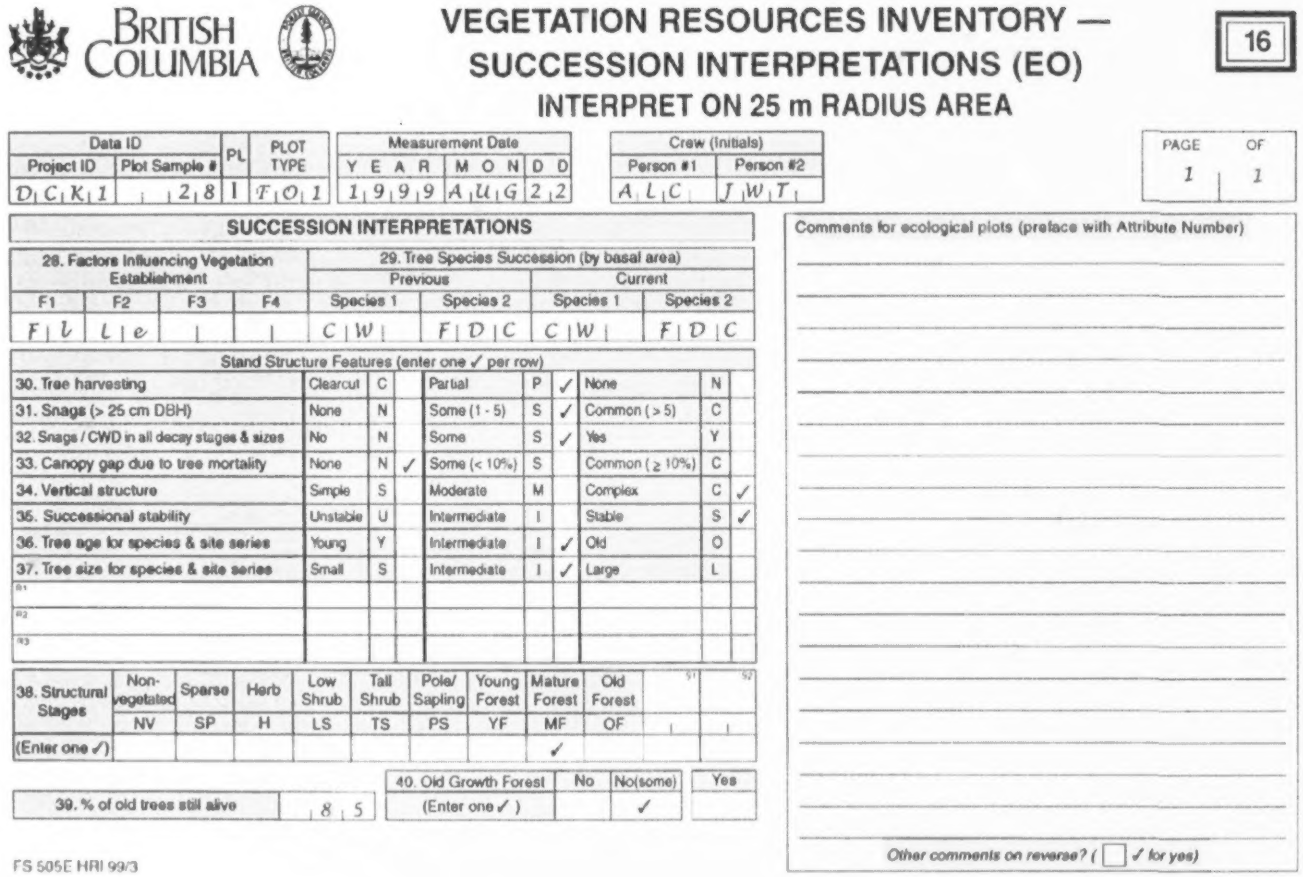
Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	I	F O 1

Comments (preface with Item Number)

#

Additional area to record features on herbs and bryoids.

Figure A.21 — Sample field card 15: Herb and Moss Layers (EH) (reverse)



BRITISH COLUMBIA

VEGETATION RESOURCES INVENTORY —
SUCCESSION INTERPRETATIONS (EO)
INTERPRET ON 25 m RADIUS AREA

16

Data ID		PL	PLOT TYPE	Measurement Date			Crew (Initials)	
Project ID	Plot Sample #			YEAR	MON	DD	Person #1	Person #2
DCK1	28	1	FO1	1999	AUG	22	ALC	JWT

PAGE 1 OF 1

SUCCESSION INTERPRETATIONS

28. Factors Influencing Vegetation Establishment				29. Tree Species Succession (by basal area)			
				Previous		Current	
F1	F2	F3	F4	Species 1	Species 2	Species 1	Species 2
Fl	Le			CW	FDC	CW	FDC

Stand Structure Features (enter one ✓ per row)

30. Tree harvesting	Clearcut	C		Partial	P	✓	None	N	
31. Snags (> 25 cm DBH)	None	N		Some (1 - 5)	S	✓	Common (> 5)	C	
32. Snags / CWD in all decay stages & sizes	No	N		Some	S	✓	Yes	Y	
33. Canopy gap due to tree mortality	None	N	✓	Some (< 10%)	S		Common (≥ 10%)	C	
34. Vertical structure	Simple	S		Moderate	M		Complex	C	✓
35. Successional stability	Unstable	U		Intermediate	I		Stable	S	✓
36. Tree age for species & site series	Young	Y		Intermediate	I	✓	Old	O	
37. Tree size for species & site series	Small	S		Intermediate	I	✓	Large	L	
R1									
R2									
R3									

38. Structural Stages	Non-vegetated	Sparse	Herb	Low Shrub	Tall Shrub	Pole/ Sapling	Young Forest	Mature Forest	Old Forest	S1	S2
	NV	SP	H	LS	TS	PS	YF	MF	OF		
(Enter one ✓)								✓			

39. % of old trees still alive	85

40. Old Growth Forest	No	No(some)	Yes
(Enter one ✓)		✓	

Comments for ecological plots (preface with Attribute Number)

Other comments on reverse? (☐ ✓ for yes)

FS 505E HRI 99/3

Figure A.22 — Sample field card 16: Succession Interpretations (EO) (front).

CARD EO

Data ID		PL	PLOT TYPE
Project ID	Plot Sample #		
D C K 1	2 8	I	F O 1

Comments for ecological plots (preface with Attribute Number)

Additional area to record ecological plot comments or comments on successional items.

Figure A.23 — Sample field card 16: Succession Interpretations (EO) (reverse).

Appendix B: Ground Sampling Field Guides

This appendix contains copies of the following Field Guides.

Figure B.1 — T-1 Net Factor Procedures for Loss Indicators.

Figure B.2 — T-2 Log Grade Summaries for Fir/Pine/Larch, Common, Small Tree, and Deciduous.

Figure B.3 — T-3 Log Grade Summaries for Cedar and Hemlock/Balsam, Crown Class Codes, Partial Plot Rules.

Figure B.4 — T-4 Log Grade Summaries for Spruce and Cypress/Yew, Loss Indicator Codes, Age Measure Codes, and Tree Class.

Figure B.5 — T-5 Tree Species Codes.

Figure B.6 — T-6 Wildlife Tree Attributes (crown condition, bark retention, wood condition, visual appearance, wildlife use), CWD decay classes and Accumulation codes.

Figure B.7 — T-7 Forest Health: Damage Agent Codes.

Figure B.8 — T-8 Forest Health: Damage Agent Codes. - Continued

Figure B.9 — T-11 Damage Agent Severity Codes, plus Plot Radius Factors to Tree Face.

Figure B.10 — T-12 Hawksworth Mistletoe Scale and Estimating the Abundance of Arboreal Forage Lichens.

Figure B.11 — T-9 Forest Health: Damage Agent Ranking – Growth Reduction & Mortality Agents, Form & Quality Damage Agents.

Figure B.12 — T-10 Forest Health: Damage Agent Ranking – Early Mortality Agents, Late Mortality Agents.

Figure B.13 — T-13 Tree Identification Key – Conifers.

Figure B.14 — T-14 Tree Identification Key – Conifers continued.

Figure B.15 — T-15 Tree Identification Key – Exotic Broadleaves.

Figure B.16 — T-16 Tree Identification Key – Native Broadleaves.

Figure B.17 — R-1 Range Resources: Range Utilization Classes, Phenology Codes, Split Plot Procedures

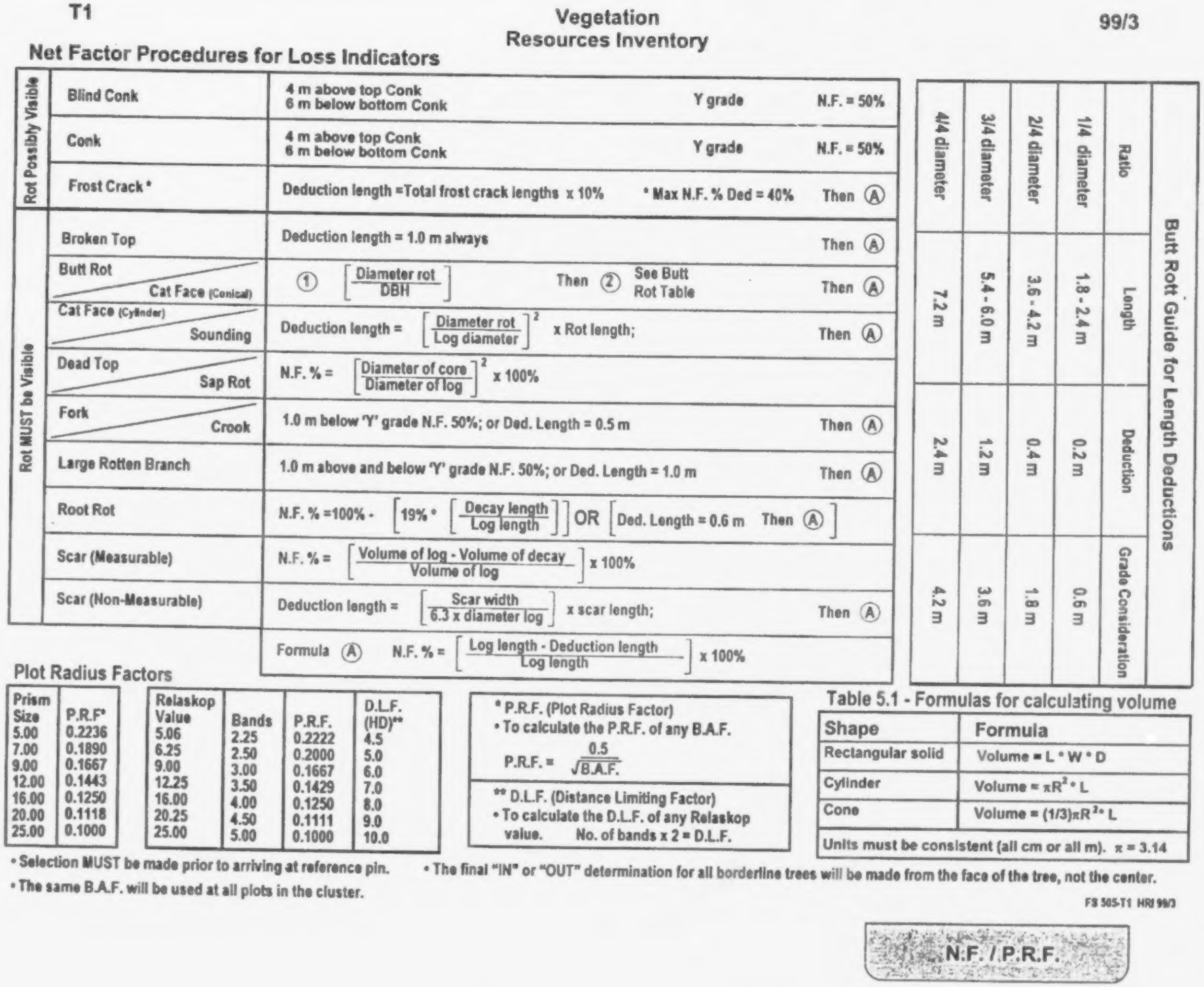
Figure B.18 — R-2 Range Resources: Low Woody Species and Intermediate Life Forms.

Figure B.19 — N-1 Random numbers for samples ending in 01–50.

Figure B.20 — N-2 Random numbers for samples ending in 51–100.

Figure B.21 — E-1 B.C. Land Cover Classification Scheme Codes – Levels I to IV.

Figure B.22 — E-1 B.C. Land Cover Classification Scheme Codes – Levels V.



T1

Vegetation
Resources Inventory

99/3

Net Factor Procedures for Loss Indicators

Rot Possibly Visible	Blind Conk	4 m above top Conk 6 m below bottom Conk	Y grade	N.F. = 50%	
	Conk	4 m above top Conk 6 m below bottom Conk	Y grade	N.F. = 50%	
	Frost Crack *	Deduction length =Total frost crack lengths x 10%	* Max N.F. % Ded = 40%	Then Ⓐ	
Rot MUST be Visible	Broken Top	Deduction length = 1.0 m always		Then Ⓐ	
	Butt Rot / Cat Face (Conical)	① $\left[\frac{\text{Diameter rot}}{\text{DBH}}\right]$	Then ② See Butt Rot Table	Then Ⓐ	
	Cat Face (Cylinder) / Sounding	Deduction length = $\left[\frac{\text{Diameter rot}}{\text{Log diameter}}\right]^2$ x Rot length;		Then Ⓐ	
	Dead Top / Sap Rot	N.F. % = $\left[\frac{\text{Diameter of core}}{\text{Diameter of log}}\right]^2$ x 100%			
	Fork / Crook	1.0 m below 'Y' grade N.F. 50%; or Ded. Length = 0.5 m		Then Ⓐ	
	Large Rotten Branch	1.0 m above and below 'Y' grade N.F. 50%; or Ded. Length = 1.0 m		Then Ⓐ	
	Root Rot	N.F. % =100% - $\left[19\% \cdot \left[\frac{\text{Decay length}}{\text{Log length}}\right]\right]$ OR [Ded. Length = 0.6 m Then Ⓐ]			
	Scar (Measurable)	N.F. % = $\left[\frac{\text{Volume of log - Volume of decay}}{\text{Volume of log}}\right]$ x 100%			
	Scar (Non-Measurable)	Deduction length = $\left[\frac{\text{Scar width}}{6.3 \text{ x diameter log}}\right]$ x scar length;		Then Ⓐ	
		Formula Ⓐ N.F. % = $\left[\frac{\text{Log length - Deduction length}}{\text{Log length}}\right]$ x 100%			

Butt Rott Guide for Length Deductions

Ratio	Length	Deduction	Grade Consideration
1/4 diameter	1.8 - 2.4 m	0.2 m	0.6 m
2/4 diameter	3.6 - 4.2 m	0.4 m	1.8 m
3/4 diameter	5.4 - 6.0 m	1.2 m	3.6 m
4/4 diameter	7.2 m	2.4 m	4.2 m

Plot Radius Factors

Prism Size	P.R.F*
5.00	0.2236
7.00	0.1890
9.00	0.1667
12.00	0.1443
16.00	0.1250
20.00	0.1118
25.00	0.1000

Relaskop Value	Bands	P.R.F.	D.L.F. (HD)**
5.06	2.25	0.2222	4.5
6.25	2.50	0.2000	5.0
9.00	3.00	0.1667	6.0
12.25	3.50	0.1429	7.0
16.00	4.00	0.1250	8.0
20.25	4.50	0.1111	9.0
25.00	5.00	0.1000	10.0

* P.R.F. (Plot Radius Factor)
- To calculate the P.R.F. of any B.A.F.

$$\text{P.R.F.} = \frac{0.5}{\sqrt{\text{B.A.F.}}}$$

** D.L.F. (Distance Limiting Factor)
- To calculate the D.L.F. of any Relaskop value. No. of bands x 2 = D.L.F.

Table 5.1 - Formulas for calculating volume

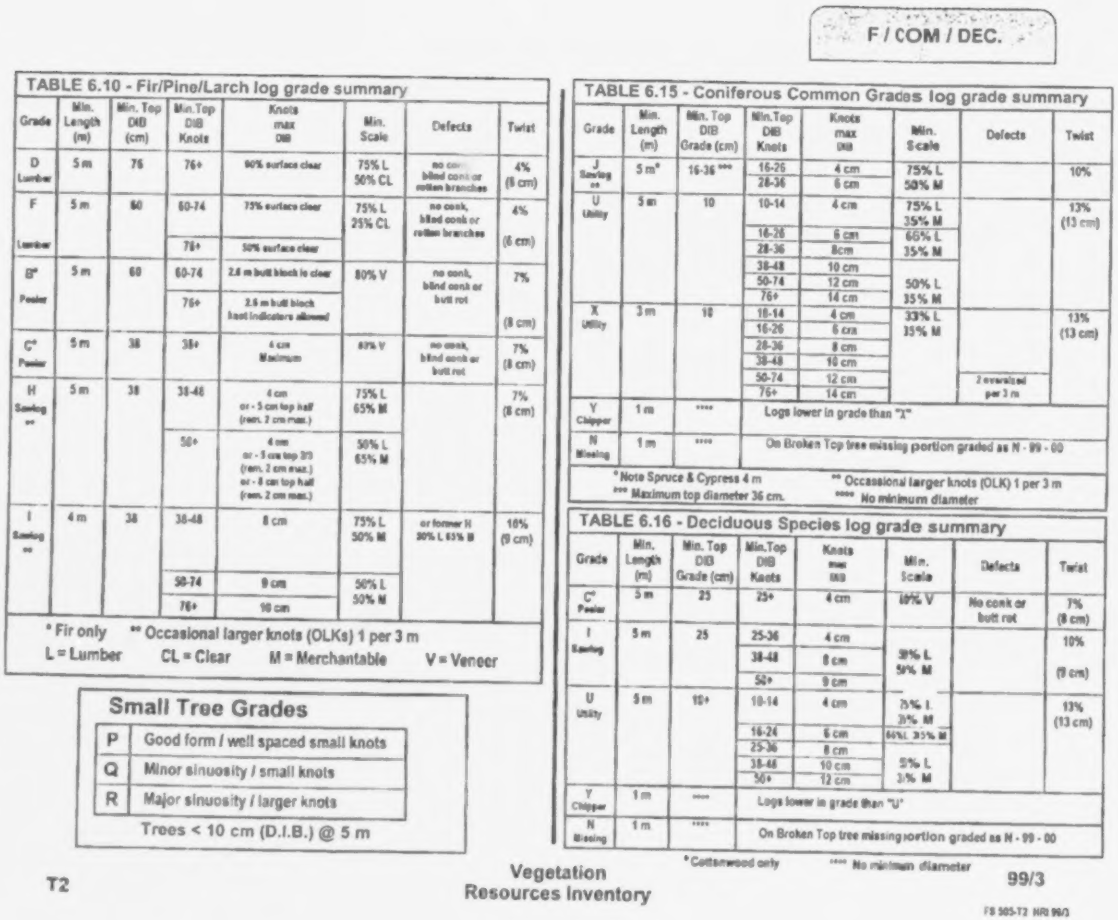
Shape	Formula
Rectangular solid	Volume = L * W * D
Cylinder	Volume = $\pi R^2 \cdot L$
Cone	Volume = $(1/3)\pi R^2 \cdot L$
Units must be consistent (all cm or all m). π = 3.14	

- Selection MUST be made prior to arriving at reference pin.
- The same B.A.F. will be used at all plots in the cluster.
- The final "IN" or "OUT" determination for all borderline trees will be made from the face of the tree, not the center.

FS 505-T1 HRI 99/3

N.F. / P.R.F.

Figure B.1 — Field Guide T-1 Net Factor Procedures for Loss Indicators.



F / COM / DEC.

TABLE 6.10 - Fir/Pine/Larch log grade summary

Grade	Min. Length (m)	Min. Top DIB (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D Lumber	5 m	76	76+	90% surface clear	75% L 50% CL	no conk, blind conk or rotten branches	4% (8 cm)
F Lumber	5 m	60	60-74	75% surface clear	75% L 25% CL	no conk, blind conk or rotten branches	4% (6 cm)
			76+	50% surface clear			
B* Peeler	5 m	60	60-74	2.6 m butt block in clear	80% V	no conk, blind conk or butt rot	7% (8 cm)
			76+	2.6 m butt block knot indicators allowed			
C* Peeler	5 m	38	38+	4 cm Maximum	60% V	no conk, blind conk or butt rot	7% (8 cm)
H Sawlog **	5 m	38	38-48	4 cm or - 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm or - 5 cm top 2/3 (rem. 2 cm max.) or - 8 cm top half (rem. 2 cm max.)	50% L 65% M		
I Sawlog **	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			58-74	9 cm	50% L 50% M		
			76+	10 cm			

* Fir only ** Occasional larger knots (OLKs) 1 per 3 m

L = Lumber CL = Clear M = Merchantable V = Veneer

TABLE 6.15 - Coniferous Common Grades log grade summary

Grade	Min. Length (m)	Min. Top DIB Grade (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
J Sawlog **	5 m*	16-36 ***	16-26	4 cm	75% L 50% M		10%
			28-36	6 cm			
U Utility	5 m	10	10-14	4 cm	75% L 35% M		13% (13 cm)
			16-26	6 cm	66% L 35% M		
			28-36	8cm			
			38-48	10 cm	50% L 35% M		
			50-74	12 cm			
			76+	14 cm			
X Utility	3 m	10	10-14	4 cm	33% L 35% M		13% (13 cm)
			16-26	6 cm			
			28-36	8 cm			
			38-48	10 cm			
			50-74	12 cm		2 oversized per 3 m	
			76+	14 cm			
Y Chipper	1 m	****	Logs lower in grade than "X"				
N Missing	1 m	****	On Broken Top tree missing portion graded as N - 99 - 00				

* Note Spruce & Cypress 4 m ** Occassional larger knots (OLK) 1 per 3 m

*** Maximum top diameter 36 cm. **** No minimum diameter

TABLE 6.16 - Deciduous Species log grade summary

Grade	Min. Length (m)	Min. Top DIB Grade (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
C* Peeler	5 m	25	25+	4 cm	60% V	No conk or butt rot	7% (8 cm)
I Sawlog	5 m	25	25-36	4 cm	30% L 50% M		10% (9 cm)
			38-48	8 cm			
			50+	9 cm			
U Utility	5 m	10+	10-14	4 cm	75% L 35% M		13% (13 cm)
			16-24	6 cm	66% L 35% M		
			25-36	8 cm	50% L 35% M		
			38-48	10 cm			
			50+	12 cm			
Y Chipper	1 m	****	Logs lower in grade than "U"				
N Missing	1 m	****	On Broken Top tree missing portion graded as N - 99 - 00				

* Cottonwood only **** No minimum diameter

Small Tree Grades

P	Good form / well spaced small knots
Q	Minor sinuosity / small knots
R	Major sinuosity / larger knots

Trees < 10 cm (D.I.B.) @ 5 m

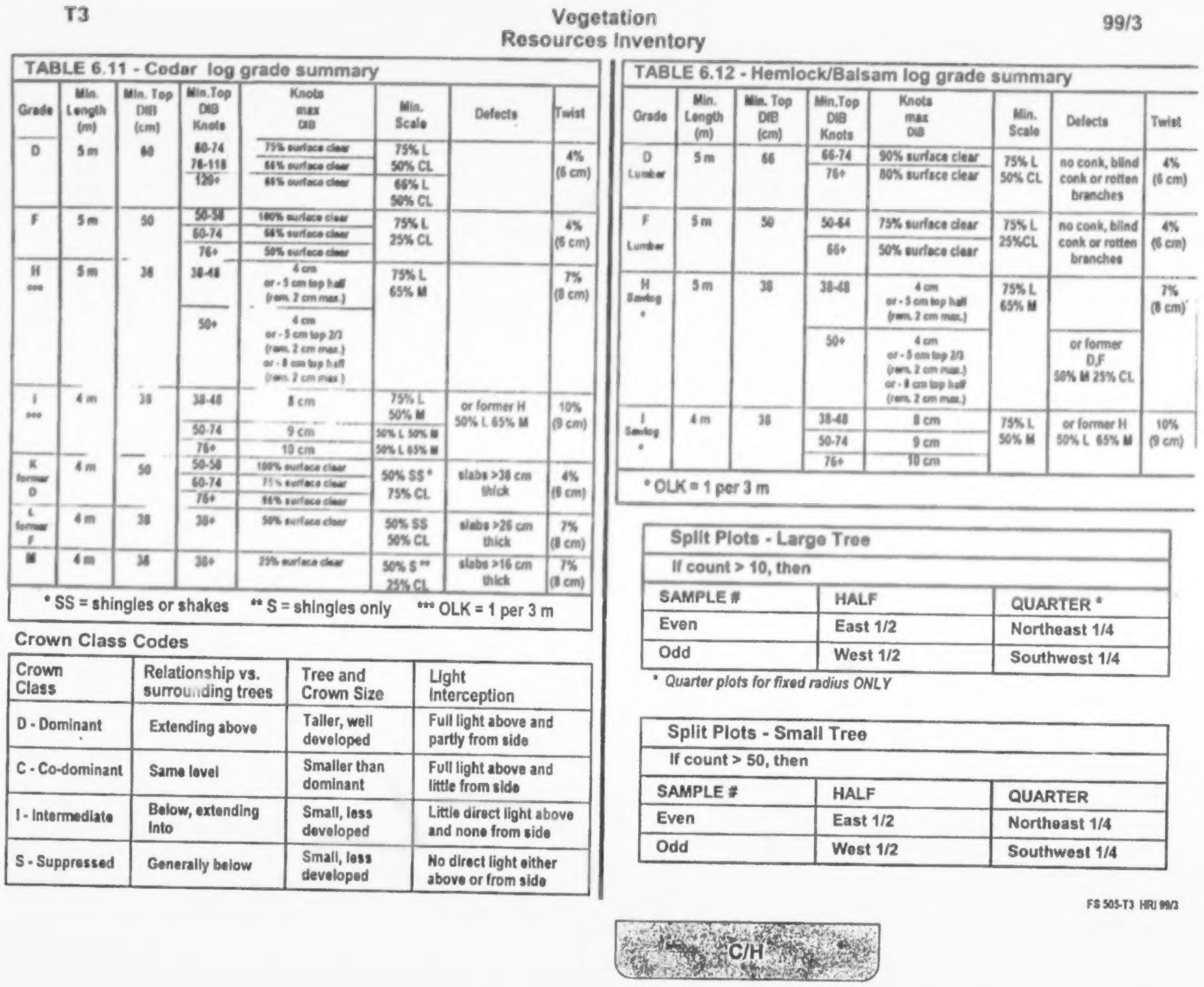
T2

Vegetation
Resources Inventory

99/3

FS 505-T2 NRI 99/3

Figure B.2 — Field Guide T-2 Log Grade Summaries for Fir/Pine/Larch, Common, Small Tree, and Deciduous.



T3 | Vegetation Resources Inventory | 99/3

TABLE 6.11 - Cedar log grade summary

Grade	Min. Length (m)	Min. Top DIB (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D	5 m	60	60-74	75% surface clear	75% L 50% CL		4% (6 cm)
			76-118	66% surface clear			
			120+	66% surface clear	66% L 50% CL		
F	5 m	50	50-58	100% surface clear	75% L 25% CL		4% (6 cm)
			60-74	66% surface clear			
			76+	50% surface clear			
H ***	5 m	38	38-48	4 cm or - 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm or - 5 cm top 2/3 (rem. 2 cm max.) or - 8 cm top half (rem. 2 cm max.)			
I ***	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm	50% L 50% M		
			76+	10 cm	50% L 65% M		
K former D	4 m	50	50-58	100% surface clear	50% SS * 75% CL	slabs >38 cm thick	4% (6 cm)
			60-74	75% surface clear			
			76+	66% surface clear			
L former F	4 m	38	38+	50% surface clear	50% SS 50% CL	slabs >26 cm thick	7% (8 cm)
M	4 m	38	38+	25% surface clear	50% S ** 25% CL	slabs >16 cm thick	7% (8 cm)

* SS = shingles or shakes ** S = shingles only *** OLK = 1 per 3 m

TABLE 6.12 - Hemlock/Balsam log grade summary

Grade	Min. Length (m)	Min. Top DIB (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D Lumber	5 m	66	66-74	90% surface clear	75% L 50% CL	no conk, blind conk or rotten branches	4% (6 cm)
			76+	80% surface clear			
F Lumber	5 m	50	50-64	75% surface clear	75% L 25%CL	no conk, blind conk or rotten branches	4% (6 cm)
			66+	50% surface clear			
H Sawlog *	5 m	38	38-48	4 cm or - 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm or - 5 cm top 2/3 (rem. 2 cm max.) or - 8 cm top half (rem. 2 cm max.)		or former D,F 50% M 25% CL	
I Sawlog *	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm			
			76+	10 cm			

* OLK = 1 per 3 m

Crown Class Codes

Crown Class	Relationship vs. surrounding trees	Tree and Crown Size	Light Interception
D - Dominant	Extending above	Taller, well developed	Full light above and partly from side
C - Co-dominant	Same level	Smaller than dominant	Full light above and little from side
I - Intermediate	Below, extending into	Small, less developed	Little direct light above and none from side
S - Suppressed	Generally below	Small, less developed	No direct light either above or from side

Split Plots - Large Tree

If count > 10, then

SAMPLE #	HALF	QUARTER *
Even	East 1/2	Northeast 1/4
Odd	West 1/2	Southwest 1/4

* Quarter plots for fixed radius ONLY

Split Plots - Small Tree

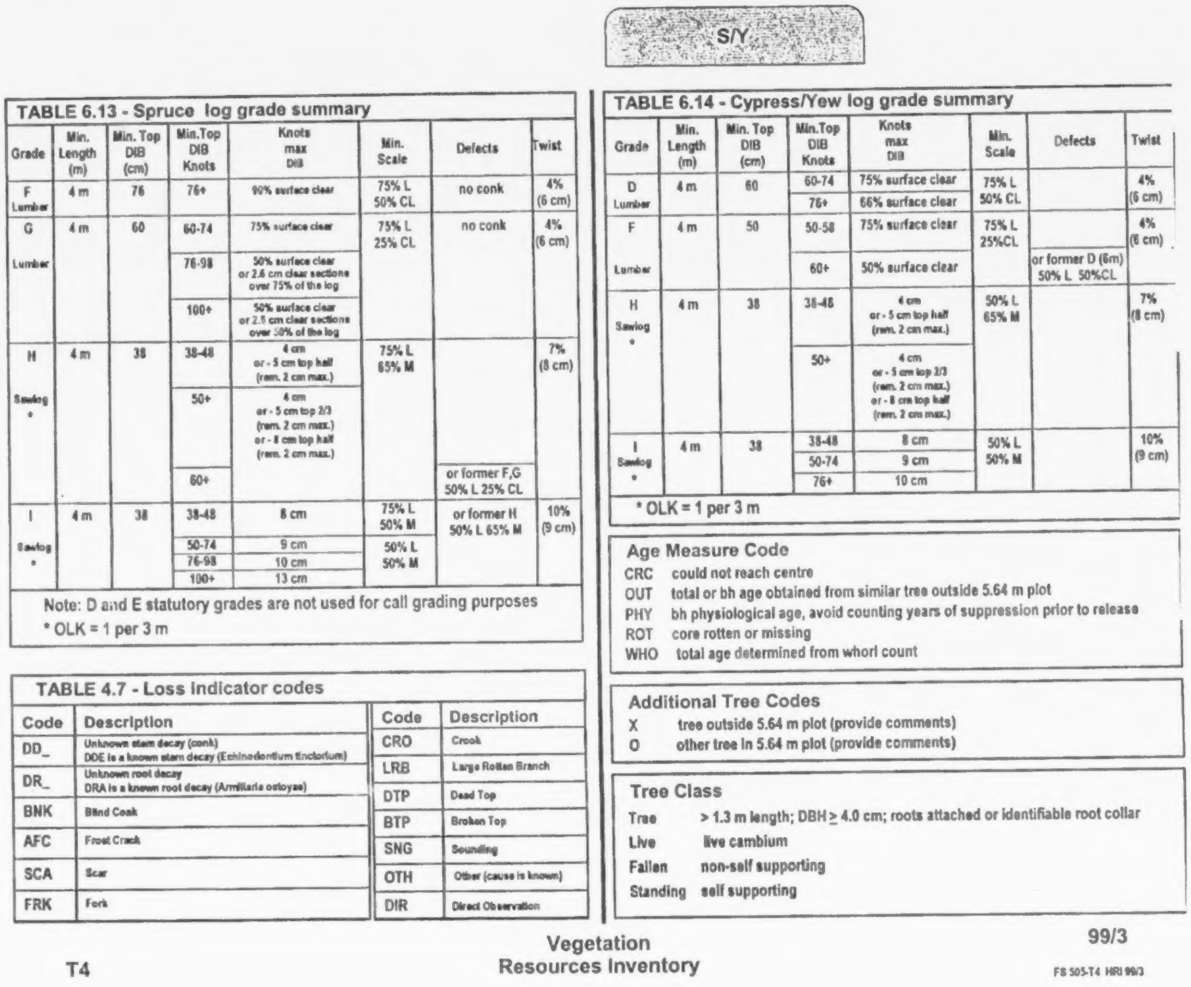
If count > 50, then

SAMPLE #	HALF	QUARTER
Even	East 1/2	Northeast 1/4
Odd	West 1/2	Southwest 1/4

FS 505-T3 HRI 99/3

C/H

Figure B.3 — Field Guide T-3 Log Grade Summaries for Cedar and Hemlock/Balsam, Crown Class Codes, Partial Plot Rules.



S/Y

TABLE 6.13 - Spruce log grade summary

Grade	Min. Length (m)	Min. Top DIB (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
F Lumber	4 m	76	76+	90% surface clear	75% L 50% CL	no conk	4% (6 cm)
G Lumber	4 m	60	60-74	75% surface clear	75% L 25% CL	no conk	4% (6 cm)
			76-98	50% surface clear or 2.6 cm clear sections over 75% of the log			
			100+	50% surface clear or 2.5 cm clear sections over 50% of the log			
H Sawlog *	4 m	38	38-48	4 cm or - 5 cm top half (rem. 2 cm max.)	75% L 65% M		7% (8 cm)
			50+	4 cm or - 5 cm top 2/3 (rem. 2 cm max.) or - 8 cm top half (rem. 2 cm max.)			
			60+			or former F,G 50% L 25% CL	
I Sawlog *	4 m	38	38-48	8 cm	75% L 50% M	or former H 50% L 65% M	10% (9 cm)
			50-74	9 cm	50% L 50% M		
			76-98	10 cm			
			100+	13 cm			

Note: D and E statutory grades are not used for call grading purposes

* OLK = 1 per 3 m

TABLE 4.7 - Loss indicator codes

Code	Description	Code	Description
DD_	Unknown stem decay (conk) DDE is a known stem decay (Echinodontium tinctorium)	CRO	Crook
DR_	Unknown root decay DRA is a known root decay (Armillaria ostoyae)	LRB	Large Rotten Branch
BNK	Blind Conk	DTP	Dead Top
AFC	Frost Crack	BTP	Broken Top
SCA	Scar	SNG	Sounding
FRK	Fork	OTH	Other (cause is known)
		DIR	Direct Observation

TABLE 6.14 - Cypress/Yew log grade summary

Grade	Min. Length (m)	Min. Top DIB (cm)	Min.Top DIB Knots	Knots max DIB	Min. Scale	Defects	Twist
D Lumber	4 m	60	60-74	75% surface clear	75% L 50% CL		4% (6 cm)
			76+	66% surface clear			
F Lumber	4 m	50	50-58	75% surface clear	75% L 25%CL		4% (6 cm)
			60+	50% surface clear		or former D (6m) 50% L 50%CL	
H Sawlog *	4 m	38	38-48	4 cm or - 5 cm top half (rem. 2 cm max.)	50% L 65% M		7% (8 cm)
			50+	4 cm or - 5 cm top 2/3 (rem. 2 cm max.) or - 8 cm top half (rem. 2 cm max.)			
I Sawlog *	4 m	38	38-48	8 cm	50% L 50% M		10% (9 cm)
			50-74	9 cm			
			76+	10 cm			

* OLK = 1 per 3 m

Age Measure Code

CRC	could not reach centre
OUT	total or bh age obtained from similar tree outside 5.64 m plot
PHY	bh physiological age, avoid counting years of suppression prior to release
ROT	core rotten or missing
WHO	total age determined from whorl count

Additional Tree Codes

X	tree outside 5.64 m plot (provide comments)
O	other tree in 5.64 m plot (provide comments)

Tree Class

Tree	> 1.3 m length; DBH ≥ 4.0 cm; roots attached or identifiable root collar
Live	live cambium
Fallen	non-self supporting
Standing	self supporting

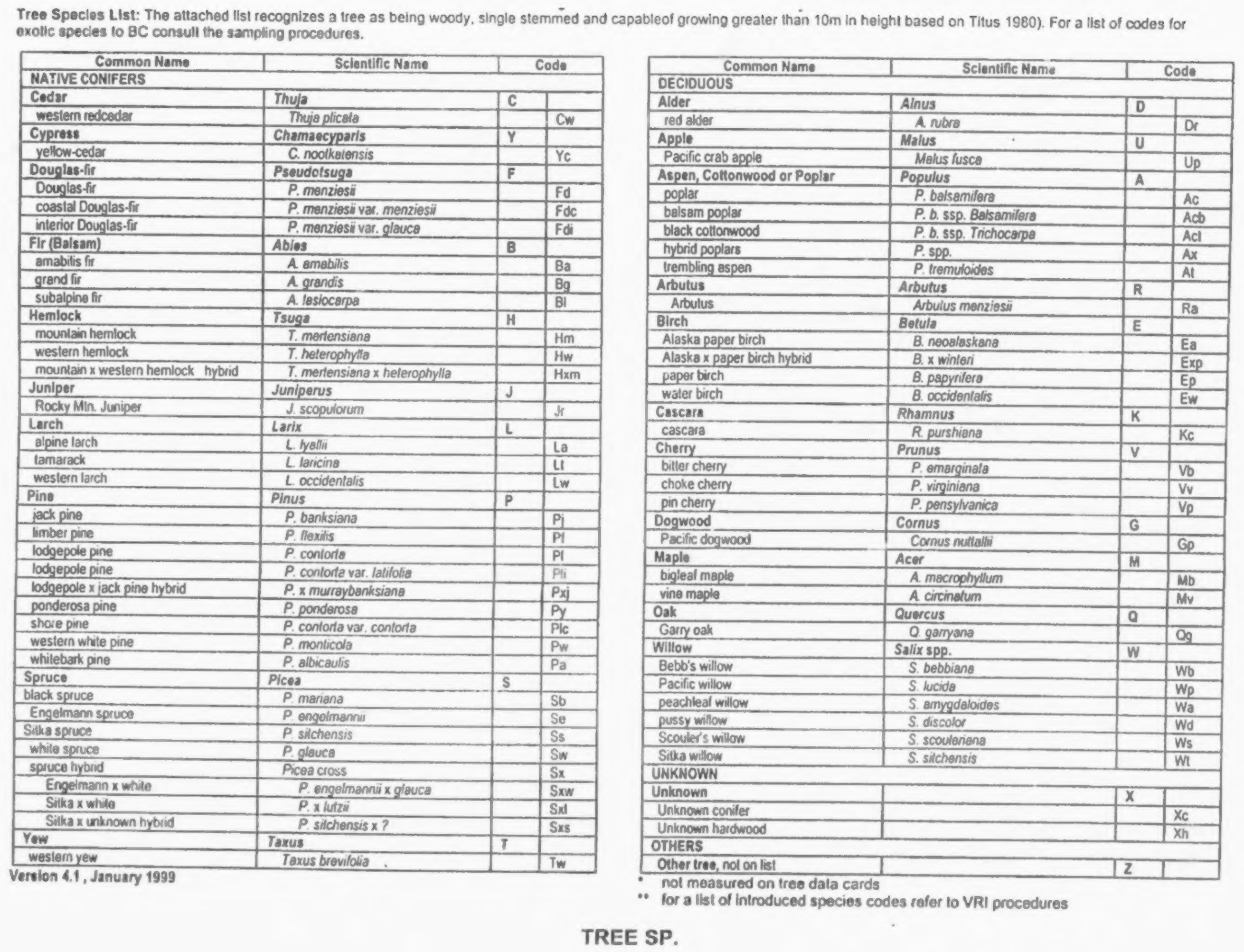
T4

Vegetation
Resources Inventory

99/3

FS 505-T4 HRI 99/3

Figure B.4 — Field Guide T-4 Log Grade Summaries for Spruce and Cypress/Yew, Loss Indicator Codes, Age Measure Codes, and Tree Class.



Tree Species List: The attached list recognizes a tree as being woody, single stemmed and capableof growing greater than 10m in height based on Titus 1980). For a list of codes for exotic species to BC consult the sampling procedures.

Common Name	Scientific Name	Code	
NATIVE CONIFERS			
Cedar	***Thuja***	C	
western redcedar	*Thuja plicata*		Cw
Cypress	***Chamaecyparis***	Y	
yellow-cedar	*C. nootkatensis*		Yc
Douglas-fir	***Pseudotsuga***	F	
Douglas-fir	*P. menziesii*		Fd
coastal Douglas-fir	*P. menziesii var. menziesii*		Fdc
interior Douglas-fir	*P. menziesii var. glauca*		Fdi
Fir (Balsam)	***Abies***	B	
amabilis fir	*A. amabilis*		Ba
grand fir	*A. grandis*		Bg
subalpine fir	*A. lasiocarpa*		Bl
Hemlock	***Tsuga***	H	
mountain hemlock	*T. mertensiana*		Hm
western hemlock	*T. heterophylla*		Hw
mountain x western hemlock hybrid	*T. mertensiana x heterophylla*		Hxm
Juniper	***Juniperus***	J	
Rocky Mtn. Juniper	*J. scopulorum*		Jr
Larch	***Larix***	L	
alpine larch	*L. lyallii*		La
tamarack	*L. laricina*		Lt
western larch	*L. occidentalis*		Lw
Pine	***Pinus***	P	
jack pine	*P. banksiana*		Pj
limber pine	*P. flexilis*		Pf
lodgepole pine	*P. contorta*		Pl
lodgepole pine	*P. contorta var. latifolia*		Pli
lodgepole x jack pine hybrid	*P. x murraybanksiana*		Pxj
ponderosa pine	*P. ponderosa*		Py
shore pine	*P. contorta var. contorta*		Plc
western white pine	*P. monticola*		Pw
whitebark pine	*P. albicaulis*		Pa
Spruce	***Picea***	S	
black spruce	*P. mariana*		Sb
Engelmann spruce	*P. engelmannii*		Se
Sitka spruce	*P. sitchensis*		Ss
white spruce	*P. glauca*		Sw
spruce hybrid	*Picea cross*		Sx
Engelmann x white	*P. engelmannii x glauca*		Sxw
Sitka x white	*P. x lutzii*		Sxl
Sitka x unknown hybrid	*P. sitchensis x ?*		Sxs
Yew	***Taxus***	T	
western yew	*Taxus brevifolia*		Tw

Version 4.1 , January 1999

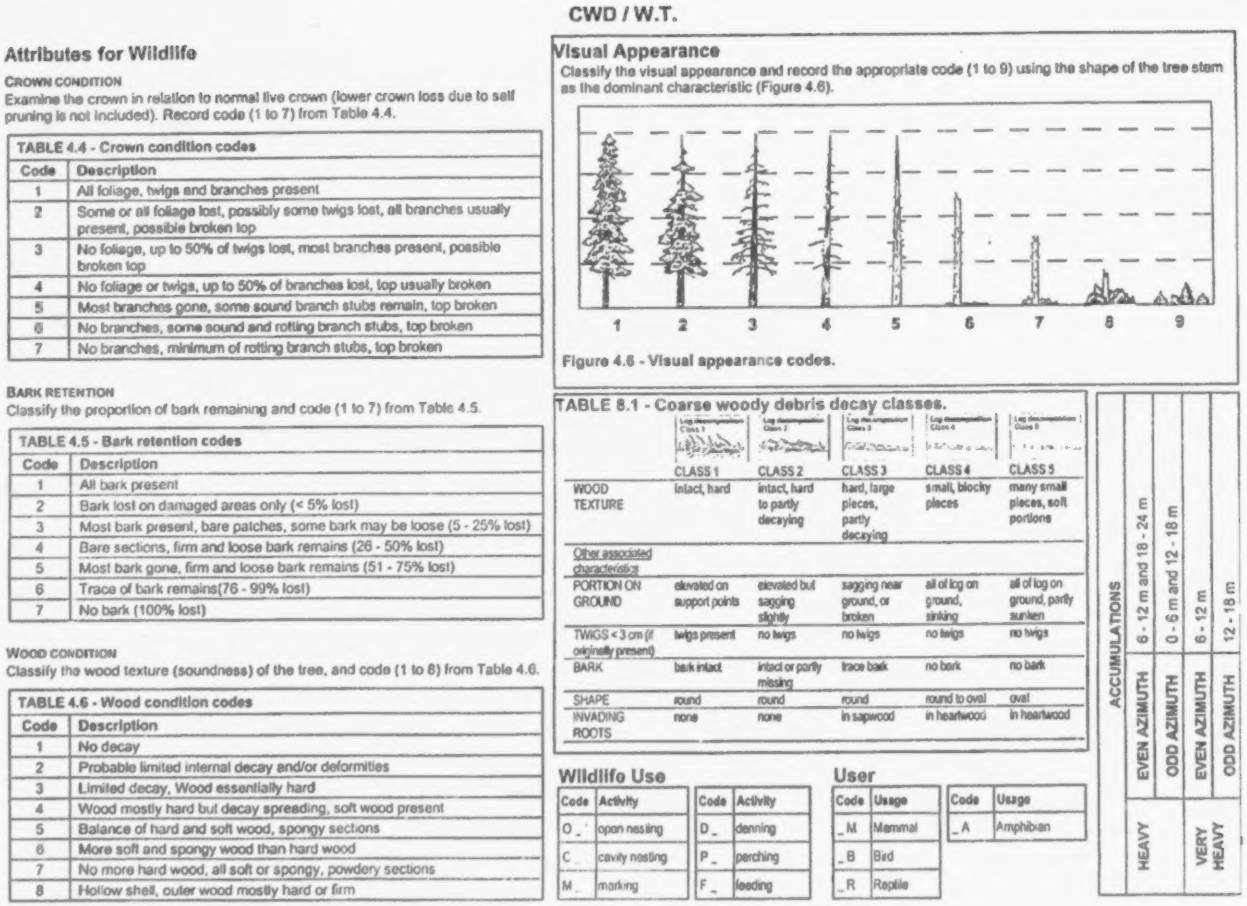
Common Name	Scientific Name	Code	
DECIDUOUS			
Alder	***Alnus***	D	
red alder	*A. rubra*		Dr
Apple	***Malus***	U	
Pacific crab apple	*Malus fusca*		Up
Aspen, Cottonwood or Poplar	***Populus***	A	
poplar	*P. balsamifera*		Ac
balsam poplar	*P. b. ssp. Balsamifera*		Acb
black cottonwood	*P. b. ssp. Trichocarpa*		Act
hybrid poplars	*P. spp.*		Ax
trembling aspen	*P. tremuloides*		At
Arbutus	***Arbutus***	R	
Arbutus	*Arbutus menziesii*		Ra
Birch	***Betula***	E	
Alaska paper birch	*B. neoalaskana*		Ea
Alaska x paper birch hybrid	*B. x winteri*		Exp
paper birch	*B. papyrifera*		Ep
water birch	*B. occidentalis*		Ew
Cascara	***Rhamnus***	K	
cascara	*R. purshiana*		Kc
Cherry	***Prunus***	V	
bitter cherry	*P. emarginata*		Vb
choke cherry	*P. virginiana*		Vv
pin cherry	*P. pensylvanica*		Vp
Dogwood	***Cornus***	G	
Pacific dogwood	*Cornus nuttallii*		Gp
Maple	***Acer***	M	
bigleaf maple	*A. macrophyllum*		Mb
vine maple	*A. circinatum*		Mv
Oak	***Quercus***	Q	
Garry oak	*Q. garryana*		Qg
Willow	***Salix spp.***	W	
Bebb's willow	*S. bebbiana*		Wb
Pacific willow	*S. lucida*		Wp
peachleaf willow	*S. amygdaloides*		Wa
pussy willow	*S. discolor*		Wd
Scouler's willow	*S. scouleriana*		Ws
Sitka willow	*S. sitchensis*		Wt
UNKNOWN			
Unknown		X	
Unknown conifer			Xc
Unknown hardwood			Xh
OTHERS			
Other tree, not on list		Z	

* not measured on tree data cards

** for a list of introduced species codes refer to VRI procedures

TREE SP.

Figure B.5 — Field Guide T-5 Tree Species Codes.



CWD / W.T.

Attributes for Wildlife

CROWN CONDITION

Examine the crown in relation to normal live crown (lower crown loss due to self pruning is not included). Record code (1 to 7) from Table 4.4.

TABLE 4.4 - Crown condition codes

Code	Description
1	All foliage, twigs and branches present
2	Some or all foliage lost, possibly some twigs lost, all branches usually present, possible broken top
3	No foliage, up to 50% of twigs lost, most branches present, possible broken top
4	No foliage or twigs, up to 50% of branches lost, top usually broken
5	Most branches gone, some sound branch stubs remain, top broken
6	No branches, some sound and rotting branch stubs, top broken
7	No branches, minimum of rotting branch stubs, top broken

BARK RETENTION

Classify the proportion of bark remaining and code (1 to 7) from Table 4.5.

TABLE 4.5 - Bark retention codes

Code	Description
1	All bark present
2	Bark lost on damaged areas only (< 5% lost)
3	Most bark present, bare patches, some bark may be loose (5 - 25% lost)
4	Bare sections, firm and loose bark remains (26 - 50% lost)
5	Most bark gone, firm and loose bark remains (51 - 75% lost)
6	Trace of bark remains(76 - 99% lost)
7	No bark (100% lost)

WOOD CONDITION

Classify the wood texture (soundness) of the tree, and code (1 to 8) from Table 4.6.

TABLE 4.6 - Wood condition codes

Code	Description
1	No decay
2	Probable limited internal decay and/or deformities
3	Limited decay, Wood essentially hard
4	Wood mostly hard but decay spreading, soft wood present
5	Balance of hard and soft wood, spongy sections
6	More soft and spongy wood than hard wood
7	No more hard wood, all soft or spongy, powdery sections
8	Hollow shell, outer wood mostly hard or firm

Visual Appearance

Classify the visual appearance and record the appropriate code (1 to 9) using the shape of the tree stem as the dominant characteristic (Figure 4.6).

Figure 4.6 - Visual appearance codes.

TABLE 8.1 - Coarse woody debris decay classes.

	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5
WOOD TEXTURE	intact, hard	intact, hard to partly decaying	hard, large pieces, partly decaying	small, blocky pieces	many small pieces, soft portions
Other associated characteristics					
PORTION ON GROUND	elevated on support points	elevated but sagging slightly	sagging near ground, or broken	all of log on ground, sinking	all of log on ground, partly sunken
TWIGS < 3 cm (if originally present)	twigs present	no twigs	no twigs	no twigs	no twigs
BARK	bark intact	intact or partly missing	trace bark	no bark	no bark
SHAPE	round	round	round	round to oval	oval
INVADING ROOTS	none	none	in sapwood	in heartwood	in heartwood

Wildlife Use

Code	Activity
O_	open nesting
C_	cavity nesting
M_	marking

Code	Activity
D_	denning
P_	perching
F_	feeding

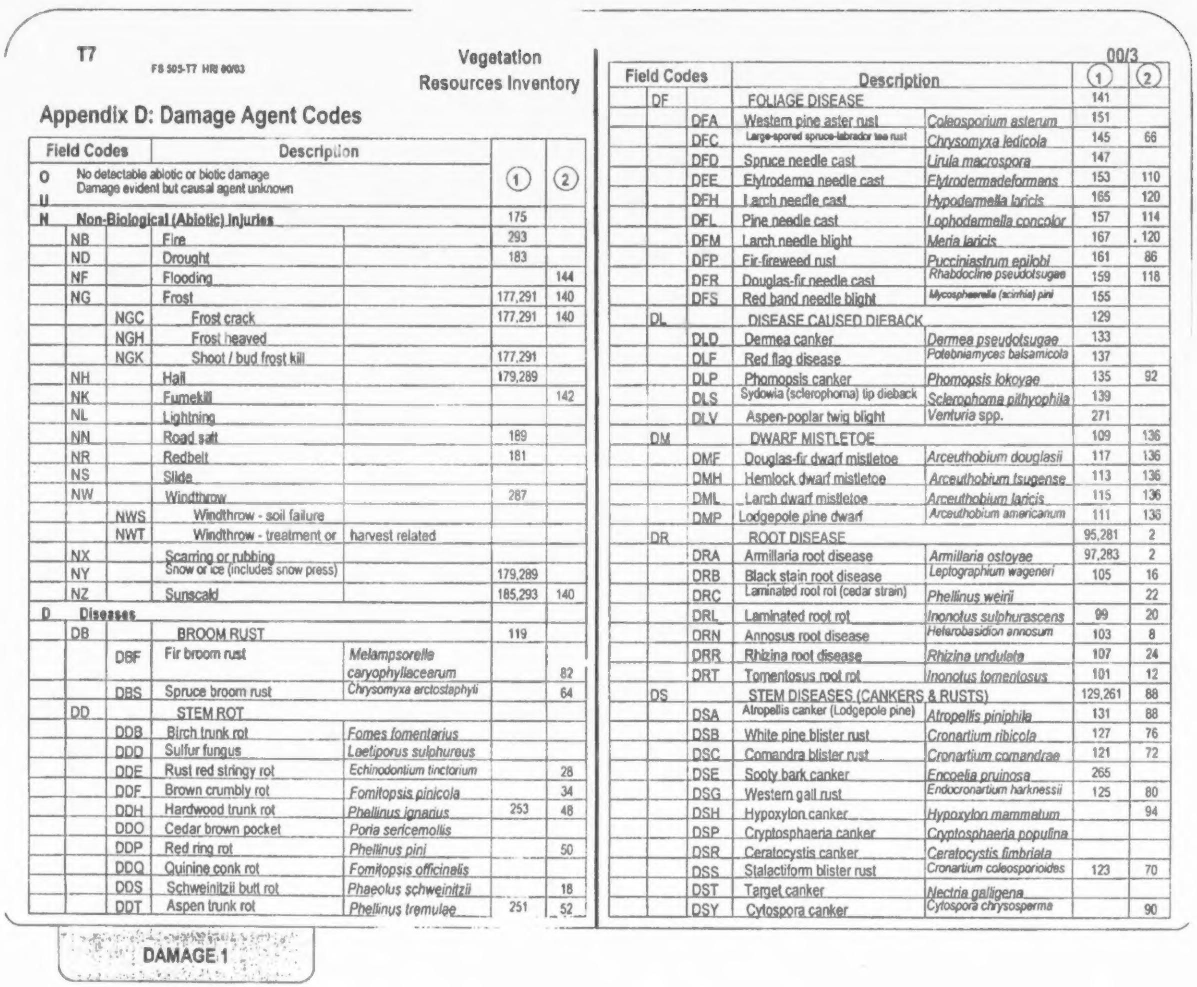
User

Code	Usage
_M	Mammal
_B	Bird
_R	Reptile

Code	Usage
_A	Amphibian

ACCUMULATIONS		
HEAVY	EVEN AZIMUTH	6 - 12 m and 18 - 24 m
	ODD AZIMUTH	0 - 6 m and 12 - 18 m
VERY HEAVY	EVEN AZIMUTH	6 - 12 m
	ODD AZIMUTH	12 - 18 m

Figure B.6 — Field Guide T-6 Wildlife Tree Attributes (crown condition, bark retention, wood condition, visual appearance, wildlife use), CWD decay classes and Accumulation codes.



T7

FS 505-T7 HRI 00/03

Vegetation
Resources Inventory

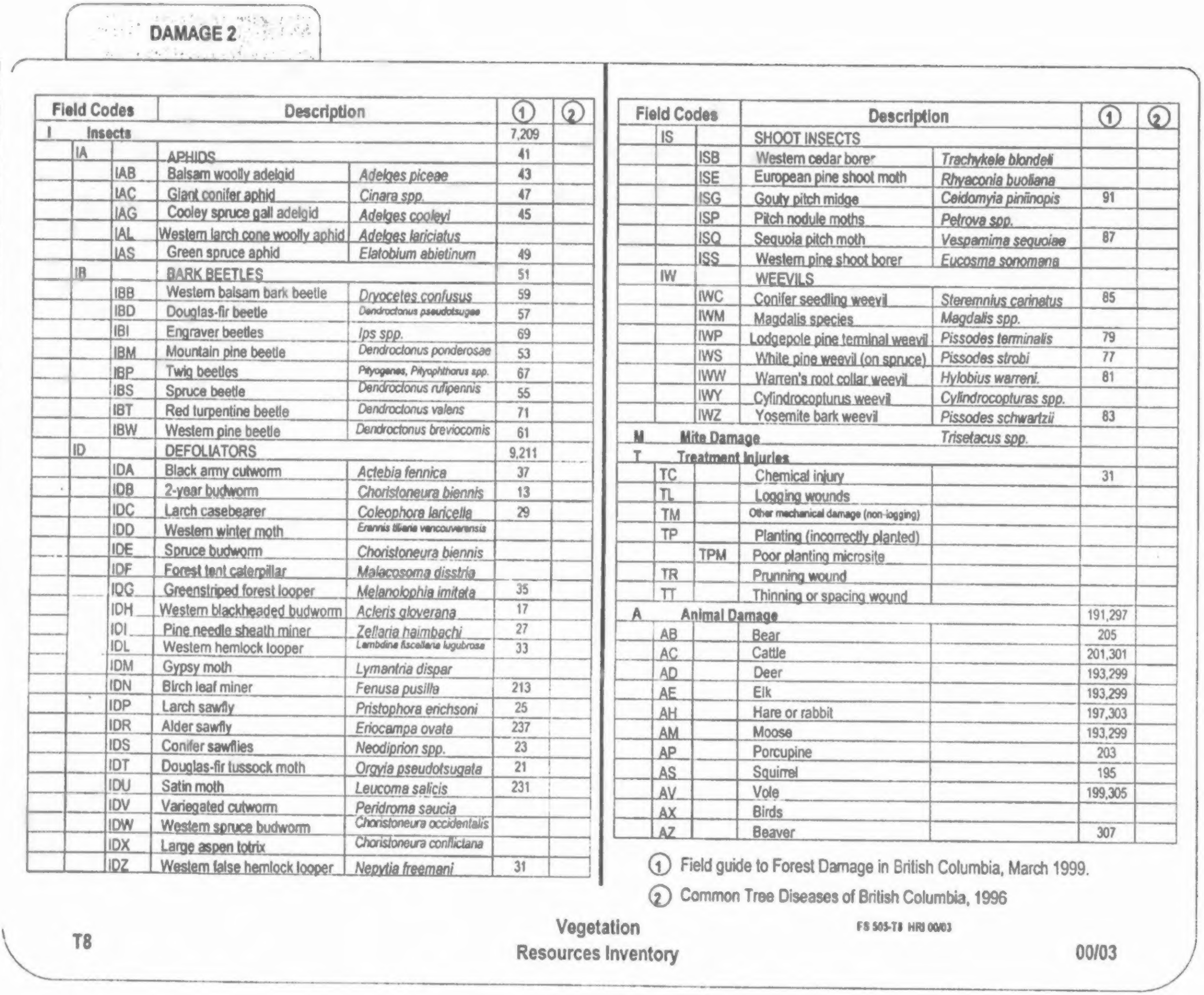
Appendix D: Damage Agent Codes

00/3

Field Codes			Description		①	②
O			No detectable abiotic or biotic damage			
U			Damage evident but causal agent unknown			
N			**Non-Biological (Abiotic) Injuries**		175	
	NB		Fire		293	
	ND		Drought		183	
	NF		Flooding			144
	NG		Frost		177,291	140
		NGC	Frost crack		177,291	140
		NGH	Frost heaved			
		NGK	Shoot / bud frost kill		177,291	
	NH		Hail		179,289	
	NK		Fumekill			142
	NL		Lightning			
	NN		Road salt		189	
	NR		Redbelt		181	
	NS		Slide			
	NW		Windthrow		287	
		NWS	Windthrow - soil failure			
		NWT	Windthrow - treatment or	harvest related		
	NX		Scarring or rubbing			
	NY		Snow or ice (includes snow press)		179,289	
	NZ		Sunscald		185,293	140
D			**Diseases**			
	DB		BROOM RUST		119	
		DBF	Fir broom rust	*Melampsorella caryophyllacearum*		82
		DBS	Spruce broom rust	*Chrysomyxa arctostaphyli*		64
	DD		STEM ROT			
		DDB	Birch trunk rot	*Fomes fomentarius*		
		DDD	Sulfur fungus	*Laetiporus sulphureus*		
		DDE	Rust red stringy rot	*Echinodontium tinctorium*		28
		DDF	Brown crumbly rot	*Fomitopsis pinicola*		34
		DDH	Hardwood trunk rot	*Phellinus ignarius*	253	48
		DDO	Cedar brown pocket	*Poria sericemollis*		
		DDP	Red ring rot	*Phellinus pini*		50
		DDQ	Quinine conk rot	*Fomitopsis officinalis*		
		DDS	Schweinitzii butt rot	*Phaeolus schweinitzii*		18
		DDT	Aspen trunk rot	*Phellinus tremulae*	251	52
	DF		FOLIAGE DISEASE		141	
		DFA	Western pine aster rust	*Coleosporium asterum*	151	
		DFC	Large-spored spruce-labrador tea rust	*Chrysomyxa ledicola*	145	66
		DFD	Spruce needle cast	*Lirula macrospora*	147	
		DFE	Elytroderma needle cast	*Elytrodermadeformans*	153	110
		DFH	Larch needle cast	*Hypodermella laricis*	165	120
		DFL	Pine needle cast	*Lophodermella concolor*	157	114
		DFM	Larch needle blight	*Meria laricis*	167	120
		DFP	Fir-fireweed rust	*Pucciniastrum epilobi*	161	86
		DFR	Douglas-fir needle cast	*Rhabdocline pseudotsugae*	159	118
		DFS	Red band needle blight	*Mycosphaerella (scirrhia) pini*	155	
	DL		DISEASE CAUSED DIEBACK		129	
		DLD	Dermea canker	*Dermea pseudotsugae*	133	
		DLF	Red flag disease	*Potebniamyces balsamicola*	137	
		DLP	Phomopsis canker	*Phomopsis lokoyae*	135	92
		DLS	Sydowia (sclerophoma) tip dieback	*Sclerophoma pithyophila*	139	
		DLV	Aspen-poplar twig blight	*Venturia* spp.	271	
	DM		DWARF MISTLETOE		109	136
		DMF	Douglas-fir dwarf mistletoe	*Arceuthobium douglasii*	117	136
		DMH	Hemlock dwarf mistletoe	*Arceuthobium tsugense*	113	136
		DML	Larch dwarf mistletoe	*Arceuthobium laricis*	115	136
		DMP	Lodgepole pine dwarf	*Arceuthobium americanum*	111	136
	DR		ROOT DISEASE		95,281	2
		DRA	Armillaria root disease	*Armillaria ostoyae*	97,283	2
		DRB	Black stain root disease	*Leptographium wageneri*	105	16
		DRC	Laminated root rot (cedar strain)	*Phellinus weirii*		22
		DRL	Laminated root rot	*Inonotus sulphurascens*	99	20
		DRN	Annosus root disease	*Heterobasidion annosum*	103	8
		DRR	Rhizina root disease	*Rhizina undulata*	107	24
		DRT	Tomentosus root rot	*Inonotus tomentosus*	101	12
	DS		STEM DISEASES (CANKERS & RUSTS)		129,261	88
		DSA	Atropellis canker (Lodgepole pine)	*Atropellis piniphila*	131	88
		DSB	White pine blister rust	*Cronartium ribicola*	127	76
		DSC	Comandra blister rust	*Cronartium comandrae*	121	72
		DSE	Sooty bark canker	*Encoelia pruinosa*	265	
		DSG	Western gall rust	*Endocronartium harknessii*	125	80
		DSH	Hypoxylon canker	*Hypoxylon mammatum*		94
		DSP	Cryptosphaeria canker	*Cryptosphaeria populina*		
		DSR	Ceratocystis canker	*Ceratocystis fimbriata*		
		DSS	Stalactiform blister rust	*Cronartium coleosporioides*	123	70
		DST	Target canker	*Nectria galligena*		
		DSY	Cytospora canker	*Cytospora chrysosperma*		90

DAMAGE 1

Figure B.7 — Field Guide T-7 Forest Health: Damage Agent Codes.



DAMAGE 2

Field Codes			Description		①	②
I	Insects				7,209	
	IA		APHIDS		41	
		IAB	Balsam woolly adelgid	*Adelges piceae*	43	
		IAC	Giant conifer aphid	*Cinara spp.*	47	
		IAG	Cooley spruce gall adelgid	*Adelges cooleyi*	45	
		IAL	Western larch cone woolly aphid	*Adelges lariciatus*		
		IAS	Green spruce aphid	*Elatobium abietinum*	49	
	IB		BARK BEETLES		51	
		IBB	Western balsam bark beetle	*Dryocetes confusus*	59	
		IBD	Douglas-fir beetle	*Dendroctonus pseudotsugae*	57	
		IBI	Engraver beetles	*Ips spp.*	69	
		IBM	Mountain pine beetle	*Dendroctonus ponderosae*	53	
		IBP	Twig beetles	*Pityogenes, Pityophthorus spp.*	67	
		IBS	Spruce beetle	*Dendroctonus rufipennis*	55	
		IBT	Red turpentine beetle	*Dendroctonus valens*	71	
		IBW	Western pine beetle	*Dendroctonus breviocomis*	61	
	ID		DEFOLIATORS		9,211	
		IDA	Black army cutworm	*Actebia fennica*	37	
		IDB	2-year budworm	*Choristoneura biennis*	13	
		IDC	Larch casebearer	*Coleophora laricella*	29	
		IDD	Western winter moth	*Erannis tiliaria vancouverensis*		
		IDE	Spruce budworm	*Choristoneura biennis*		
		IDF	Forest tent caterpillar	*Malacosoma disstria*		
		IDG	Greenstriped forest looper	*Melanolophia imitata*	35	
		IDH	Western blackheaded budworm	*Acleris gloverana*	17	
		IDI	Pine needle sheath miner	*Zellaria haimbachi*	27	
		IDL	Western hemlock looper	*Lambdina fiscellaria lugubrosa*	33	
		IDM	Gypsy moth	*Lymantria dispar*		
		IDN	Birch leaf miner	*Fenusa pusilla*	213	
		IDP	Larch sawfly	*Pristophora erichsoni*	25	
		IDR	Alder sawfly	*Eriocampa ovata*	237	
		IDS	Conifer sawflies	*Neodiprion spp.*	23	
		IDT	Douglas-fir tussock moth	*Orgyia pseudotsugata*	21	
		IDU	Satin moth	*Leucoma salicis*	231	
		IDV	Variegated cutworm	*Peridroma saucia*		
		IDW	Western spruce budworm	*Choristoneura occidentalis*		
		IDX	Large aspen totrix	*Choristoneura conflictana*		
		IDZ	Western false hemlock looper	*Nepytia freemani*	31	

Field Codes			Description		①	②
	IS		SHOOT INSECTS			
		ISB	Western cedar borer	*Trachykele blondeli*		
		ISE	European pine shoot moth	*Rhyaconia buoliana*		
		ISG	Gouty pitch midge	*Ceidomyia piniinopis*	91	
		ISP	Pitch nodule moths	*Petrova spp.*		
		ISQ	Sequoia pitch moth	*Vespamima sequoiae*	87	
		ISS	Western pine shoot borer	*Eucosma sonomana*		
	IW		WEEVILS			
		IWC	Conifer seedling weevil	*Steremnius carinatus*	85	
		IWM	Magdalis species	*Magdalis spp.*		
		IWP	Lodgepole pine terminal weevil	*Pissodes terminalis*	79	
		IWS	White pine weevil (on spruce)	*Pissodes strobi*	77	
		IWW	Warren's root collar weevil	*Hylobius warreni.*	81	
		IWY	Cylindrocopturus weevil	*Cylindrocopturas spp.*		
		IWZ	Yosemite bark weevil	*Pissodes schwartzii*	83	
M	Mite Damage			*Trisetacus spp.*		
T	Treatment Injuries					
	TC		Chemical injury		31	
	TL		Logging wounds			
	TM		Other mechanical damage (non-logging)			
	TP		Planting (incorrectly planted)			
		TPM	Poor planting microsite			
	TR		Prunning wound			
	TT		Thinning or spacing wound			
A	Animal Damage				191,297	
	AB		Bear		205	
	AC		Cattle		201,301	
	AD		Deer		193,299	
	AE		Elk		193,299	
	AH		Hare or rabbit		197,303	
	AM		Moose		193,299	
	AP		Porcupine		203	
	AS		Squirrel		195	
	AV		Vole		199,305	
	AX		Birds			
	AZ		Beaver		307	

① Field guide to Forest Damage in British Columbia, March 1999.

② Common Tree Diseases of British Columbia, 1996

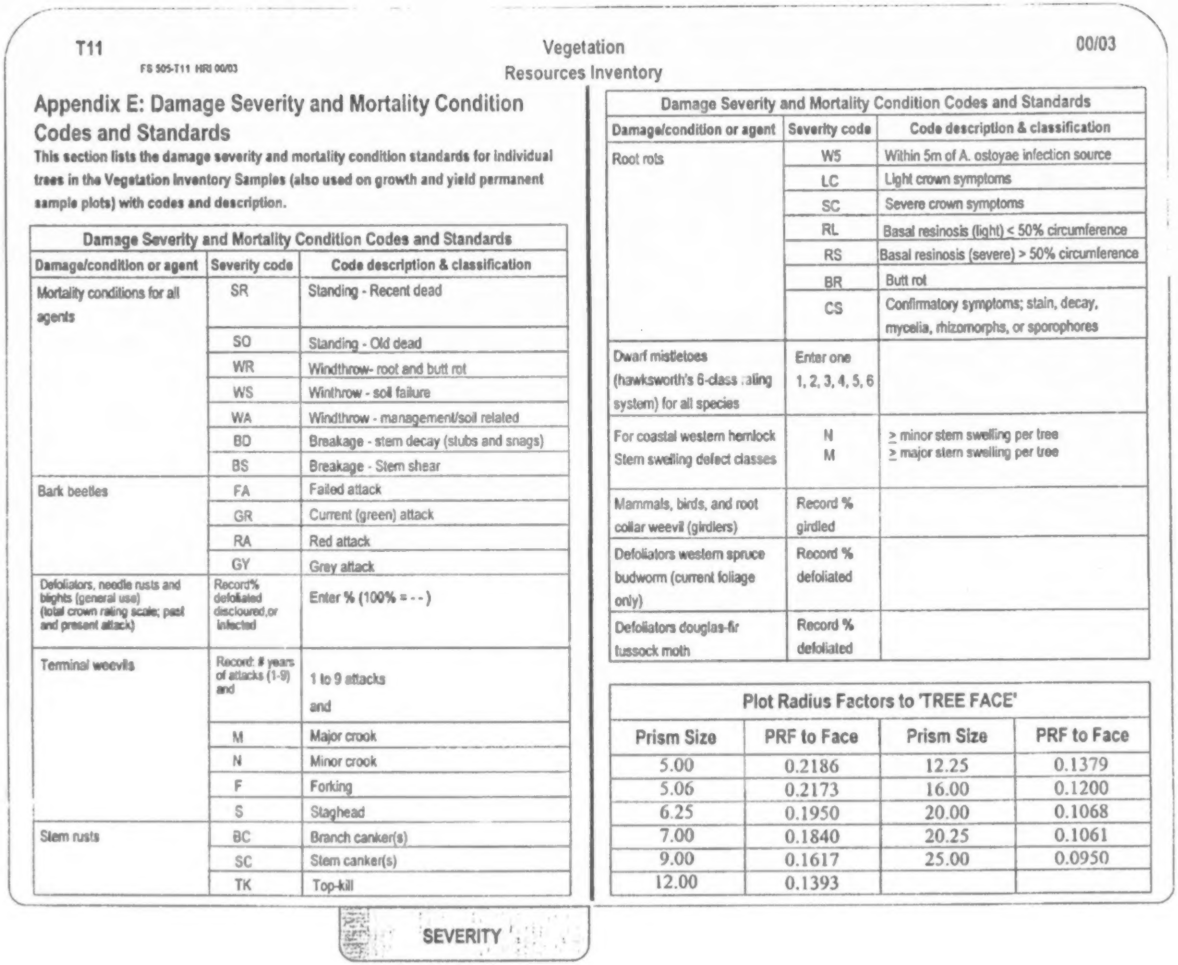
T8

Vegetation
Resources Inventory

FS 505-T8 HRI 00/03

00/03

Figure B.8 — Field Guide T-8 Forest Health: Damage Agent Codes - Continued.



T11 FS 505-T11 HRI 00/03

Vegetation
Resources Inventory

00/03

Appendix E: Damage Severity and Mortality Condition Codes and Standards

This section lists the damage severity and mortality condition standards for individual trees in the Vegetation Inventory Samples (also used on growth and yield permanent sample plots) with codes and description.

Damage Severity and Mortality Condition Codes and Standards

Damage/condition or agent	Severity code	Code description & classification
Mortality conditions for all agents	SR	Standing - Recent dead
	SO	Standing - Old dead
	WR	Windthrow- root and butt rot
	WS	Winthrow - soil failure
	WA	Windthrow - management/soil related
	BD	Breakage - stem decay (stubs and snags)
	BS	Breakage - Stem shear
Bark beetles	FA	Failed attack
	GR	Current (green) attack
	RA	Red attack
	GY	Grey attack
Defoliators, needle rusts and blights (general use) (total crown rating scale; past and present attack)	Record% defoliated discloured,or infected	Enter % (100% = - -)
Terminal weevils	Record: # years of attacks (1-9) and	1 to 9 attacks and
	M	Major crook
	N	Minor crook
	F	Forking
	S	Staghead
Stem rusts	BC	Branch canker(s)
	SC	Stem canker(s)
	TK	Top-kill

Damage Severity and Mortality Condition Codes and Standards

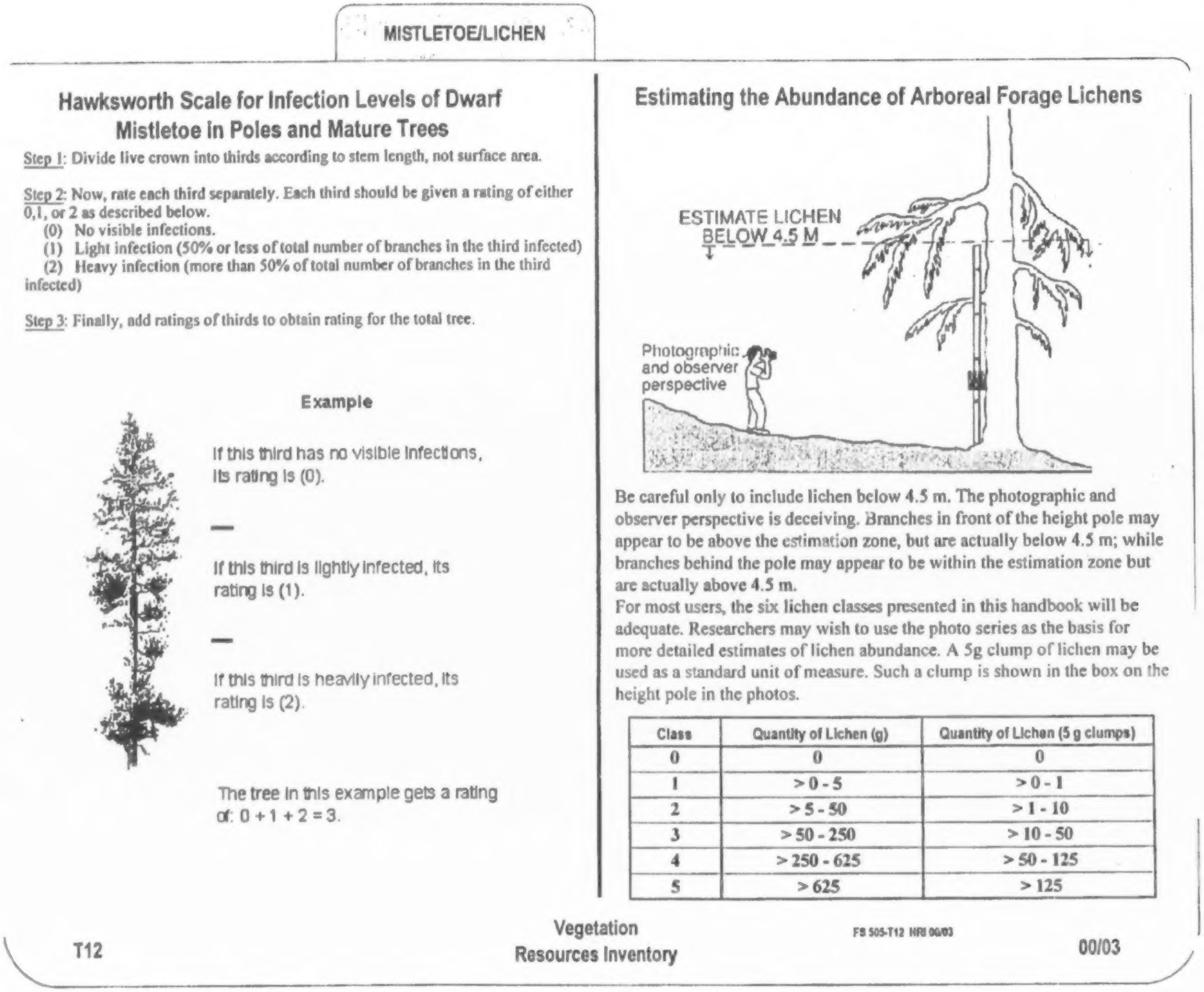
Damage/condition or agent	Severity code	Code description & classification
Root rots	W5	Within 5m of A. ostoyae infection source
	LC	Light crown symptoms
	SC	Severe crown symptoms
	RL	Basal resinosis (light) < 50% circumference
	RS	Basal resinosis (severe) > 50% circumference
	BR	Butt rot
	CS	Confirmatory symptoms; stain, decay, mycelia, rhizomorphs, or sporophores
Dwarf mistletoes (hawksworth's 6-class rating system) for all species	Enter one 1, 2, 3, 4, 5, 6	
For coastal western hemlock Stem swelling defect classes	N M	≥ minor stem swelling per tree ≥ major stem swelling per tree
Mammals, birds, and root collar weevil (girdlers)	Record % girdled	
Defoliators western spruce budworm (current foliage only)	Record % defoliated	
Defoliators douglas-fir tussock moth	Record % defoliated	

Plot Radius Factors to 'TREE FACE'

Prism Size	PRF to Face	Prism Size	PRF to Face
5.00	0.2186	12.25	0.1379
5.06	0.2173	16.00	0.1200
6.25	0.1950	20.00	0.1068
7.00	0.1840	20.25	0.1061
9.00	0.1617	25.00	0.0950
12.00	0.1393		

SEVERITY

Figure B 9 — Field Guide T-11 Damage Agent Severity Codes, plus Plot Radius Factors to Tree Face



MISTLETOE/LICHEN

Hawksworth Scale for Infection Levels of Dwarf Mistletoe in Poles and Mature Trees

Step 1: Divide live crown into thirds according to stem length, not surface area.

Step 2: Now, rate each third separately. Each third should be given a rating of either 0,1, or 2 as described below.

(0) No visible infections.
(1) Light infection (50% or less of total number of branches in the third infected)
(2) Heavy infection (more than 50% of total number of branches in the third infected)

Step 3: Finally, add ratings of thirds to obtain rating for the total tree.

Example

If this third has no visible infections, its rating is (0).

—

If this third is lightly infected, its rating is (1).

—

If this third is heavily infected, its rating is (2).

The tree in this example gets a rating of: 0 + 1 + 2 = 3.

Estimating the Abundance of Arboreal Forage Lichens

Be careful only to include lichen below 4.5 m. The photographic and observer perspective is deceiving. Branches in front of the height pole may appear to be above the estimation zone, but are actually below 4.5 m; while branches behind the pole may appear to be within the estimation zone but are actually above 4.5 m.

For most users, the six lichen classes presented in this handbook will be adequate. Researchers may wish to use the photo series as the basis for more detailed estimates of lichen abundance. A 5g clump of lichen may be used as a standard unit of measure. Such a clump is shown in the box on the height pole in the photos.

Class	Quantity of Lichen (g)	Quantity of Lichen (5 g clumps)
0	0	0
1	> 0 - 5	> 0 - 1
2	> 5 - 50	> 1 - 10
3	> 50 - 250	> 10 - 50
4	> 250 - 625	> 50 - 125
5	> 625	> 125

T12 Vegetation Resources Inventory FS 505-T12 HRB 00/03 00/03

Figure B.10 — Field Guide T-12 Hawksworth Mistletoe Scale and Estimating the Abundance of Arboreal Forage Lichens

Forest Damage Agent Rank & Priority For Damage Appraisal & Treatment Response Based on Estimated Growth and Yield Impacts

	Growth Reduction & Mortality Damage Agents - Biogeoclimatic Zone											
Rank	BWBS	SBPS	SBS	ESSF	MS	ICH	IDF	PP	MH	CWH	CDF	Rank
1	DRT	DMP	DRT	DRT	DRA	DRA	DRA	DRA	DRS	DMH	DRL	1
2	IDE	WS	DMP	DRA	DRT	DRT	IDW	IDT	DRN	DRN	IAB	2
3	DSN	WC	DDP	IDB	DRB	DRL	DRL	IDW	DMH	DRA	IAB	3
4	IDF	DSN	IDF	DDE	DMP	DDE	DMP	DFE		DDE	ISB	4
5	IDX	DRA	IDB	DDP	EDW	DMP	IDP	DMF		DDP	DRB	5
6	WS		WS	IAG	WS	IDL	WS	DRS		DRL	IAS	6
7	DDP		DRA	WS	EDP	DML	DML	DRL		IAS		7
8	AR		DSN	DMP	DML	WS	DSB	DFR		IAB		8
9	IDB		IDN	DRS	IDC	IDW	DMF	IDS		IAG		9
10			IAG	DSN	IDI	IAG	IDI			IDH		10
11			DRS		IDF	IAC	DRS			IDB		11
12			IDH		IDH	DMH	DRB			IDL		12
13			DBF		IAC	IDH	DRN					13
14			DRL		IAG	DRN	IDF					14
15			DRB		IAS	DRB	DFE					15
16			IDS		DBS	IDC	DFM					16
17			IDX			IDF	DFB					17
18			IDR			IDX	IDT					18
19						DSN	DDP					19
20						IDP	IDD					20
21						IDA	IDC					21
22						DRS	IDP					22
23						DBF	IAC					23
24						DRC						24
25						IDN						25

NB. (1) Damage agent rankings are a 1st Approximation that are reviewed and revised periodically.
(2) Stem decays (DD's) although a significant damage agent are assessed by the Inventory Branch, and are only shown here to provide a context for the rankings.
(3) *Italicized* and **emboldened** damage agents indicate the top-ranking selections for the Pest Damage Appraisal Matrix (Table 1). The lowest rank is underline indicating the cut-off for selection. Some damage agents have been skipped-over for several reasons: (a) they are well represented by other biogeoclimatic units, (b) the damage is on deciduous hosts, (c) more epidemiology of the damage agent is required before ranking can be done, or ((d) the damage agents were not presently considered a significant impact by the subcommittee, but need further review for the 2nd Approximation of the Matrix.

	Form and Quality Damage Agents - Biogeoclimatic Zone											
Rank	BWBS	SBPS	SBS	ESSF	MS	ICH	IDF	PP	MH	CWH	CDF	Rank
1	IWS	DSS	IWS	IWS	DSA	IWS	DSA	WC		IWS	DSB	1
2	DSA	DSA	DSS	WM	DSS	DSA	DSS	ISS		DSB	ISB	2
3	DSS	WC	DSA	WE	IWS	DSB	IWP			WD	IWS	3
4	AF	ISP	IWP	AF	IWP	DSS	DSB			WE	ISQ	4
5	AR		WM	AH	ISP	WD	DSX			ISB		5
6	WM		AH	IWP	DLS	WM	WC			ISQ		6
7	WE		AF	DSA	ISS	WE	WB			DLL		7
8	AD		WC	DSS	IWZ	AF	WD			AH		8
9	AH		DL	AR	WM	ISP	ISS					9
10	IWP		DSX	ISP	WE	DSX						10
11			ISP	IWZ		IWP						11
12			IWZ			DL						12
13						WC						13
14						WB						14

NB. (1) Damage agent rankings are a 1st Approximation that are reviewed and revised periodically.
(2) Stem decays (DD's) although a significant damage agent are assessed by the Inventory Branch, and are only shown here to provide a context for the rankings.
(3) *Italicized* and **emboldened** damage agents indicate the top-ranking selections for the Pest Damage Appraisal Matrix (Table 1). The lowest rank is underline indicating the cut-off for selection. Some damage agents have been skipped-over for several reasons: (a) they are well represented by other biogeoclimatic units, (b) the damage is on deciduous hosts, (c) more epidemiology of the damage agent is required before ranking can be done, or ((d) the damage agents were not presently considered a significant impact by the subcommittee, but need further review for the 2nd Approximation of the Matrix.

FH RANKING

Figure B.11 — Field Guide T-9 Forest Health: Damage Agent Ranking – Growth Reduction & Mortality Agents, Form & Quality Damage Agents.

FH RANKING

Forest Damage Agent Rank & Priority For Damage Appraisal & Treatment Response Based on Estimated Growth and Yield Impacts

Early Mortality Damage Agents - Biogeoclimatic Zone												
Rank	BWBS	SBPS	SBS	ESSF	MS	ICH	IDF	PP	MH	CWH	CDF	Rank
1	***DSG***	***DSG***	***DSC***	***AY***	***DSC***	***DRR***	IWW	WC	***AY***	***WD***	WD	1
2	***AFK***	***WH***	***DSG***	***AF***	***DSG***	***DSC***	***DSC***	DSC	***AF***	***WY***	WV	2
3	***WH***	IWW	IWW	***IWW***	IWW	***DSG***	***DSG***	WV		IWC		3
4	AY	DSC	***WH***	***DSC***	AD	IWW	DRR	WH		DRR		4
5	IWW	IBI	IDA	***WH***	WC	IDA	IDA	AF				5
6	IWB	WV	***AF***	***DSG***	IBI	***AF***	AD	AH				6
7			DRR	WV	IDI	***WH***	***WH***	WD				7
8			WV	IDA	WH	***WV***	AF					8
9			AY		WP	***WP***	WP					9
10			IBI		DRR	IWZ	***AY***					10
11			AD		WV	***WS***	***WD***					11
12			IS(salix)		WB							12
13					IBP							14

NB. (1) Damage agent rankings are a 1st Approximation that are reviewed and revised periodically.

(2) Stem decays (DD's) although a significant damage agent are assessed by the Inventory Branch, and are only shown here to provide a context for the rankings.

(3) *Italicized* and **emboldened** damage agents indicate the top-ranking selections for the Pest Damage Appraisal Matrix (Table 1). The lowest rank is underline indicating the cut-off for selection. Some damage agents have been skipped-over for several reasons: (a) they are well represented by other biogeoclimatic units, (b) on deciduous hosts, (c) the damage agents were not presently considered a significant impact by the subcommittee, but need further review for the 2nd Approximation of the Matrix.

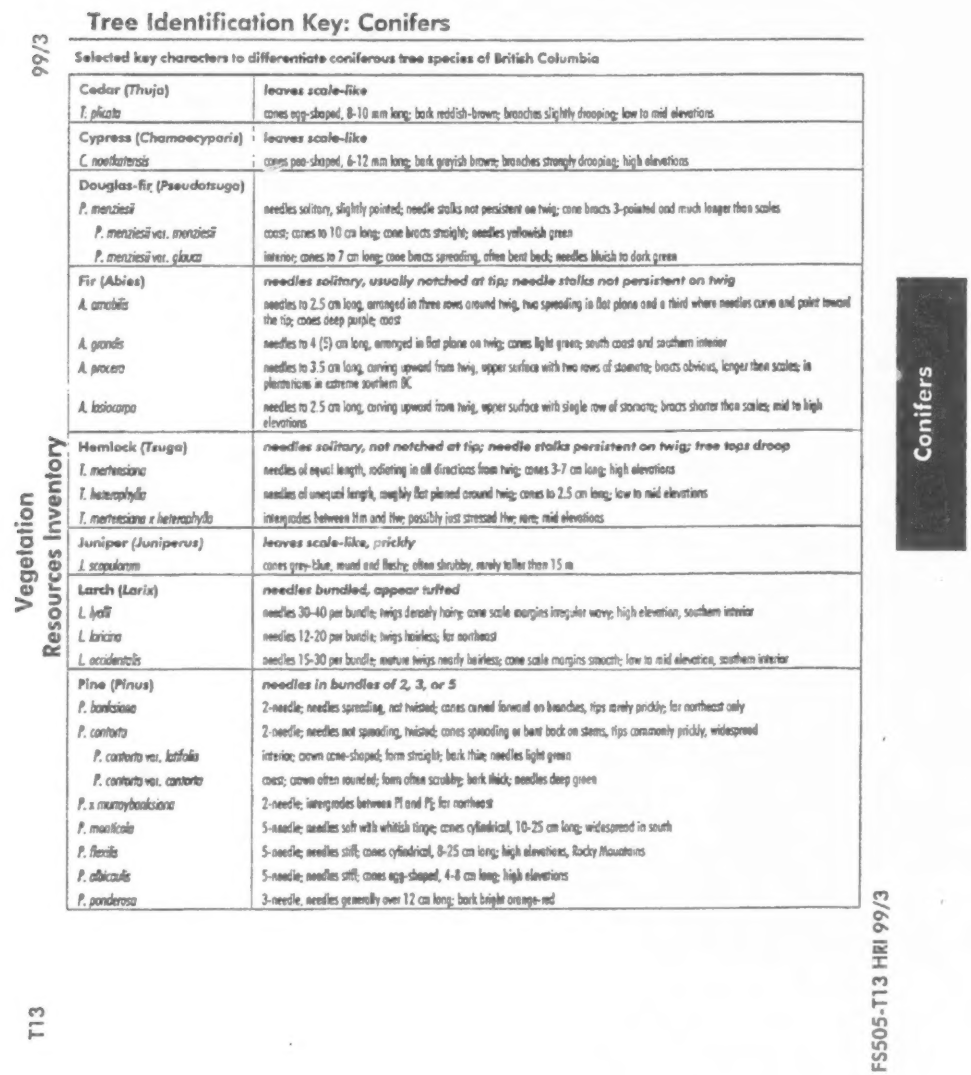
Late Mortality Damage Agents - Biogeoclimatic Zone												
Rank	BWBS	SBPS	SBS	ESSF	MS	ICH	IDF	PP	MH	CWH	CDF	Rank
1	***IBS***	***IBM***	***IBS***	***IBS***	***IBM***	***IBM***	***IBM***	***IBM***		***WP***		1
2	***IBB***		***IBM***	***IBB***	IBS	***IBB***	***IBD***	***IBT***		IBD		2
3	***AW***		***IBB***	***IBM***	IBI	***IBS***	***IBS***	***IBP***		IBM		3
4	SP		***IBD***	WP		***IBD***	***IBB***	***IBW***		IBS		4
5			***WP***	AW		***SP***	***IDT***	***IBD***				5
6			***AW***			***IDL***	WP					6
7			DRB			AW	IBI					7

NB. (1) Damage agent rankings are a 1st Approximation that are reviewed and revised periodically.

(2) Stem decays (DD's) although a significant damage agent are assessed by the Inventory Branch, and are only shown here to provide a context for the rankings.

(3) *Italicized* and **emboldened** damage agents indicate the top-ranking selections for the Pest Damage Appraisal Matrix (Table 1). The lowest rank is underline indicating the cut-off for selection. Some damage agents have been skipped-over for several reasons: (a) they are well represented by other biogeoclimatic units, (b) the damage is on deciduous hosts, (c) more epidemiology of the damage agent is required before ranking can be done, or ((d) the damage agents were not presently considered a significant impact by the subcommittee, but need further review for the 2nd Approximation of the Matrix.

Figure B.12 — Field Guide T-10 Forest Health: Damage Agent Ranking – Early Mortality Agents, Late Mortality Agents.



Tree Identification Key: Conifers

Selected key characters to differentiate coniferous tree species of British Columbia

Cedar (*Thuja*)	***leaves scale-like***
T. plicata	cones egg-shaped, 8-10 mm long; bark reddish-brown; branches slightly drooping; low to mid elevations
Cypress (*Chamaecyparis*)	***leaves scale-like***
C. nootkatensis	cones pea-shaped, 6-12 mm long; bark greyish brown; branches strongly drooping; high elevations
Douglas-fir (*Pseudotsuga*)	
P. menziesii	needles solitary, slightly pointed; needle stalks not persistent on twig; cone bracts 3-pointed and much longer than scales
P. menziesii var. *menziesii*	coast; cones to 10 cm long; cone bracts straight; needles yellowish green
P. menziesii var. *glauca*	interior; cones to 7 cm long; cone bracts spreading, often bent back; needles bluish to dark green
Fir (*Abies*)	***needles solitary, usually notched at tip; needle stalks not persistent on twig***
A. amabilis	needles to 2.5 cm long, arranged in three rows around twig, two spreading in flat plane and a third where needles curve and point toward the tip; cones deep purple; coast
A. grandis	needles to 4 (5) cm long, arranged in flat plane on twig; cones light green; south coast and southern interior
A. procera	needles to 3.5 cm long, curving upward from twig, upper surface with two rows of stomata; bracts obvious, longer than scales; in plantations in extreme southern BC
A. lasiocarpa	needles to 2.5 cm long, curving upward from twig, upper surface with single row of stomata; bracts shorter than scales; mid to high elevations
Hemlock (*Tsuga*)	***needles solitary, not notched at tip; needle stalks persistent on twig; tree tops droop***
T. mertensiana	needles of equal length, radiating in all directions from twig; cones 3-7 cm long; high elevations
T. heterophylla	needles of unequal length, roughly flat planed around twig; cones to 2.5 cm long; low to mid elevations
T. mertensiana x heterophylla	intergrades between Hm and Hw; possibly just stressed Hw; rare; mid elevations
Juniper (*Juniperus*)	***leaves scale-like, prickly***
J. scopulorum	cones grey-blue, round and fleshy; often shrubby, rarely taller than 15 m
Larch (*Larix*)	***needles bundled, appear tufted***
L. lyallii	needles 30-40 per bundle; twigs densely hairy; cone scale margins irregular wavy; high elevation, southern interior
L. laricina	needles 12-20 per bundle; twigs hairless; far northeast
L. occidentalis	needles 15-30 per bundle; mature twigs nearly hairless; cone scale margins smooth; low to mid elevation, southern interior
Pine (*Pinus*)	***needles in bundles of 2, 3, or 5***
P. banksiana	2-needle; needles spreading, not twisted; cones curved forward on branches, tips rarely prickly; far northeast only
P. contorta	2-needle; needles not spreading, twisted; cones spreading or bent back on stems, tips commonly prickly, widespread
P. contorta var. *latifolia*	interior; crown cone-shaped; form straight; bark thin; needles light green
P. contorta var. *contorta*	coast; crown often rounded; form often scrubby; bark thick; needles deep green
P. x murraybanksiana	2-needle; intergrades between Pl and Pj; far northeast
P. monticola	5-needle; needles soft with whitish tinge; cones cylindrical, 10-25 cm long; widespread in south
P. flexilis	5-needle; needles stiff; cones cylindrical, 8-25 cm long; high elevations, Rocky Mountains
P. albicaulis	5-needle; needles stiff; cones egg-shaped, 4-8 cm long; high elevations
P. ponderosa	3-needle, needles generally over 12 cm long; bark bright orange-red

99/3

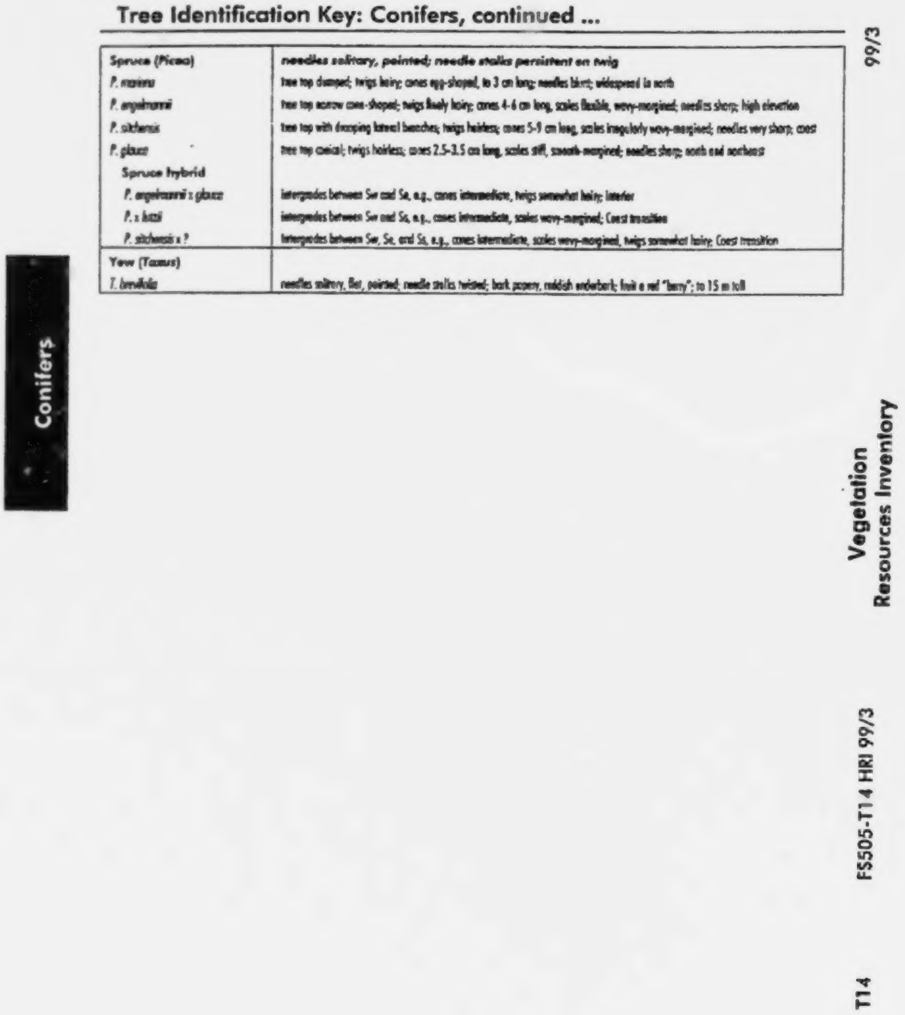
Vegetation Resources Inventory

Conifers

T13

FS505-T13 HRI 99/3

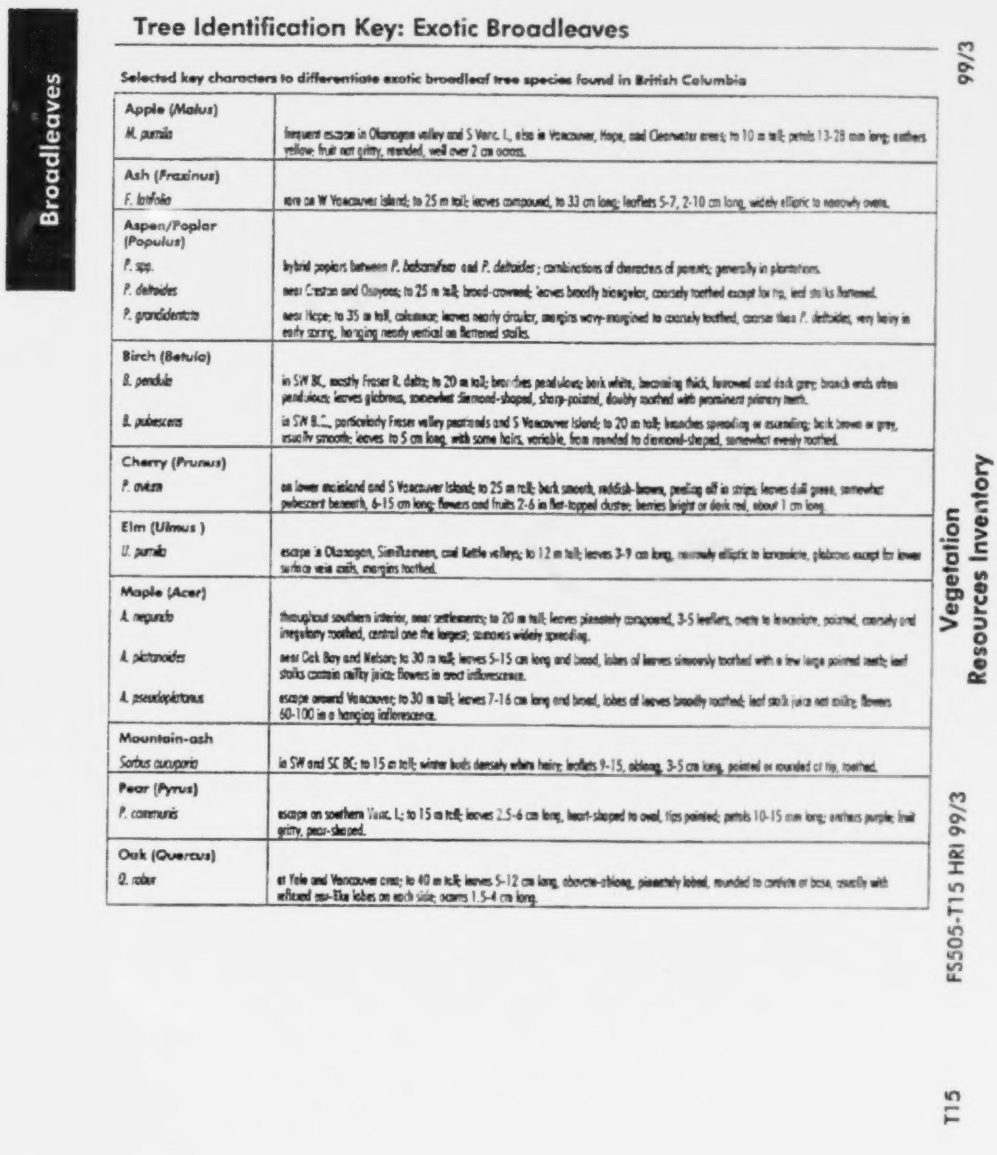
Figure B.13 — Field Guide T-13 Tree Identification Key – Conifers.



Tree Identification Key: Conifers, continued ...

Spruce (*Picea*)	***needles solitary, pointed; needle stalks persistent on twig***
P. mariana	tree top clumped; twigs hairy; cones egg-shaped, to 3 cm long; needles blunt; widespread in north
P. engelmannii	tree top narrow cone-shaped; twigs finely hairy; cones 4-6 cm long, scales flexible, wavy-margined; needles sharp; high elevation
P. sitchensis	tree top with drooping lateral branches; twigs hairless; cones 5-9 cm long, scales irregularly wavy-margined; needles very sharp; coast
P. glauca	tree top conical; twigs hairless; cones 2.5-3.5 cm long, scales stiff, smooth-margined; needles sharp; north and northeast
Spruce hybrid	
P. engelmannii x glauca	intergrades between Sw and Se, e.g., cones intermediate, twigs somewhat hairy; Interior
P. x lutzii	intergrades between Sw and Ss, e.g., cones intermediate, scales wavy-margined; Coast transition
P. sitchensis x ?	intergrades between Sw, Se, and Ss, e.g., cones intermediate, scales wavy-margined, twigs somewhat hairy; Coast transition
Yew (*Taxus*)	
T. brevifolia	needles solitary, flat, pointed; needle stalks twisted; bark papery, reddish underbark; fruit a red "berry"; to 15 m tall

Figure B.14 — Field Guide T-14 Tree Identification Key – Conifers continued.


Broadleaves
99/3
Vegetation
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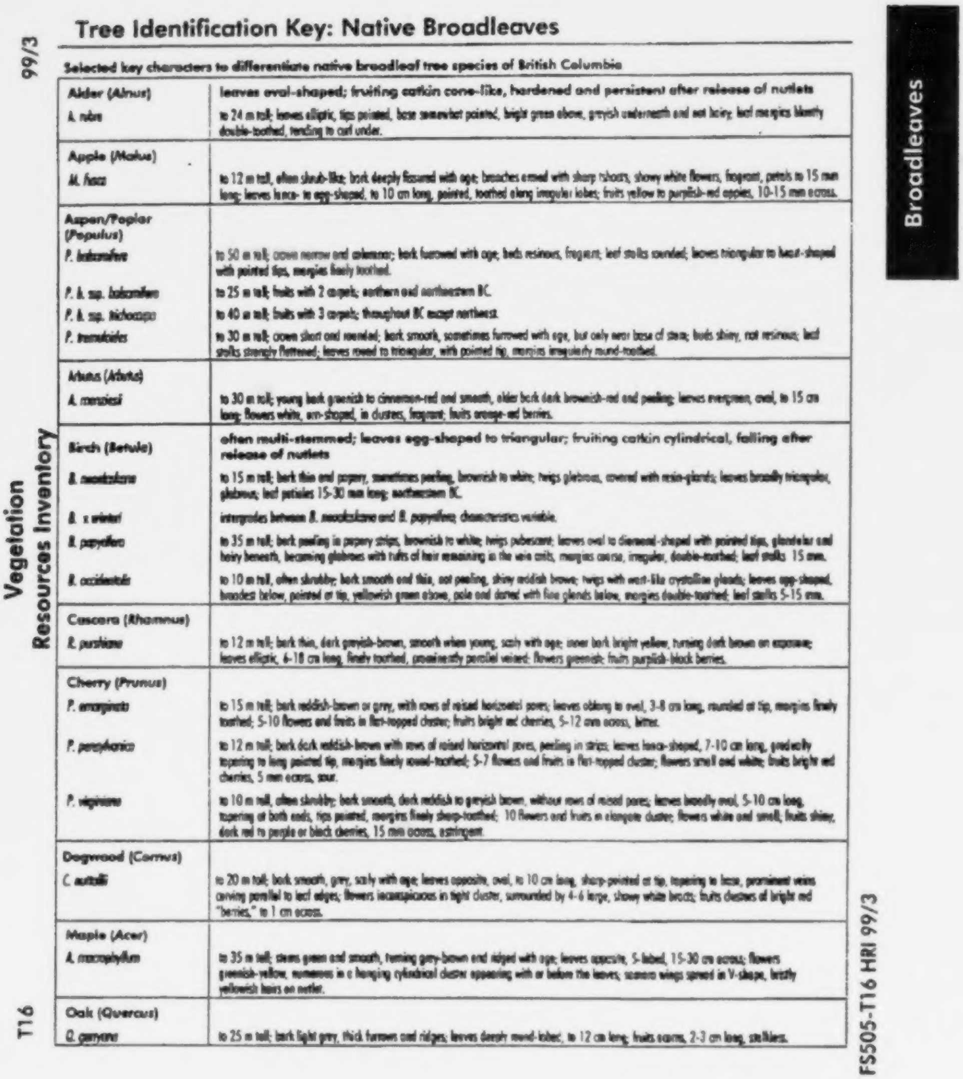
T15

Tree Identification Key: Exotic Broadleaves

Selected key characters to differentiate exotic broadleaf tree species found in British Columbia

Apple (*Malus*)	
M. pumila	frequent escape in Okanagan valley and S Vanc. I., also in Vancouver, Hope, and Clearwater areas; to 10 m tall; petals 13-28 mm long; anthers yellow; fruit not gritty, rounded, well over 2 cm across.
Ash (*Fraxinus*)	
F. latifolia	rare on W Vancouver Island; to 25 m tall; leaves compound, to 33 cm long; leaflets 5-7, 2-10 cm long, widely elliptic to narrowly ovate.
Aspen/Poplar (*Populus*)	
P. spp.	hybrid poplars between *P. balsamifera* and *P. deltoides*; combinations of characters of parents; generally in plantations.
P. deltoides	near Creston and Osoyoos; to 25 m tall; broad-crowned; leaves broadly triangular, coarsely toothed except for tip, leaf stalks flattened.
P. grandidentata	near Hope; to 35 m tall, columnar; leaves nearly circular, margins wavy-margined to coarsely toothed, coarser than *P. deltoides*, very hairy in early spring, hanging nearly vertical on flattened stalks.
Birch (*Betula*)	
B. pendula	in SW BC, mostly Fraser R. delta; to 20 m tall; branches pendulous; bark white, becoming thick, furrowed and dark grey; branch ends often pendulous; leaves glabrous, somewhat diamond-shaped, sharp-pointed, doubly toothed with prominent primary teeth.
B. pubescens	in SW B.C., particularly Fraser valley peatlands and S Vancouver Island; to 20 m tall; branches spreading or ascending; bark brown or grey, usually smooth; leaves to 5 cm long, with some hairs, variable, from rounded to diamond-shaped, somewhat evenly toothed.
Cherry (*Prunus*)	
P. avium	on lower mainland and S Vancouver Island; to 25 m tall; bark smooth, reddish-brown, peeling off in strips; leaves dull green, somewhat pubescent beneath, 6-15 cm long; flowers and fruits 2-6 in flat-topped cluster; berries bright or dark red, about 1 cm long.
Elm (*Ulmus*)	
U. pumila	escape in Okanagan, Similkameen, and Kettle valleys; to 12 m tall; leaves 3-9 cm long, narrowly elliptic to lanceolate, glabrous except for lower surface vein axils, margins toothed.
Maple (*Acer*)	
A. negundo	throughout southern interior, near settlements; to 20 m tall; leaves pinnately compound, 3-5 leaflets, ovate to lanceolate, pointed, coarsely and irregularly toothed, central one the largest; samaras widely spreading.
A. platanoides	near Oak Bay and Nelson; to 30 m tall; leaves 5-15 cm long and broad, lobes of leaves sinuously toothed with a few large pointed teeth; leaf stalks contain milky juice; flowers in erect inflorescence.
A. pseudoplatanus	escape around Vancouver; to 30 m tall; leaves 7-16 cm long and broad, lobes of leaves broadly toothed; leaf stalk juice not milky; flowers 60-100 in a hanging inflorescence.
Mountain-ash	
Sorbus aucuparia	in SW and SC BC; to 15 m tall; winter buds densely white hairy; leaflets 9-15, oblong, 3-5 cm long, pointed or rounded at tip, toothed.
Pear (*Pyrus*)	
P. communis	escape on southern Vanc. I.; to 15 m tall; leaves 2.5-6 cm long, heart-shaped to oval, tips pointed; petals 10-15 mm long; anthers purple; fruit gritty, pear-shaped.
Oak (*Quercus*)	
Q. robur	at Yale and Vancouver area; to 40 m tall; leaves 5-12 cm long, obovate-oblong, pinnately lobed, rounded to cordate at base, usually with reflexed ear-like lobes on each side; acorns 1.5-4 cm long.

Figure B.15 — Field Guide T-15 Tree Identification Key – Exotic Broadleaves.



99/3

Vegetation Resources Inventory

T16

Broadleaves

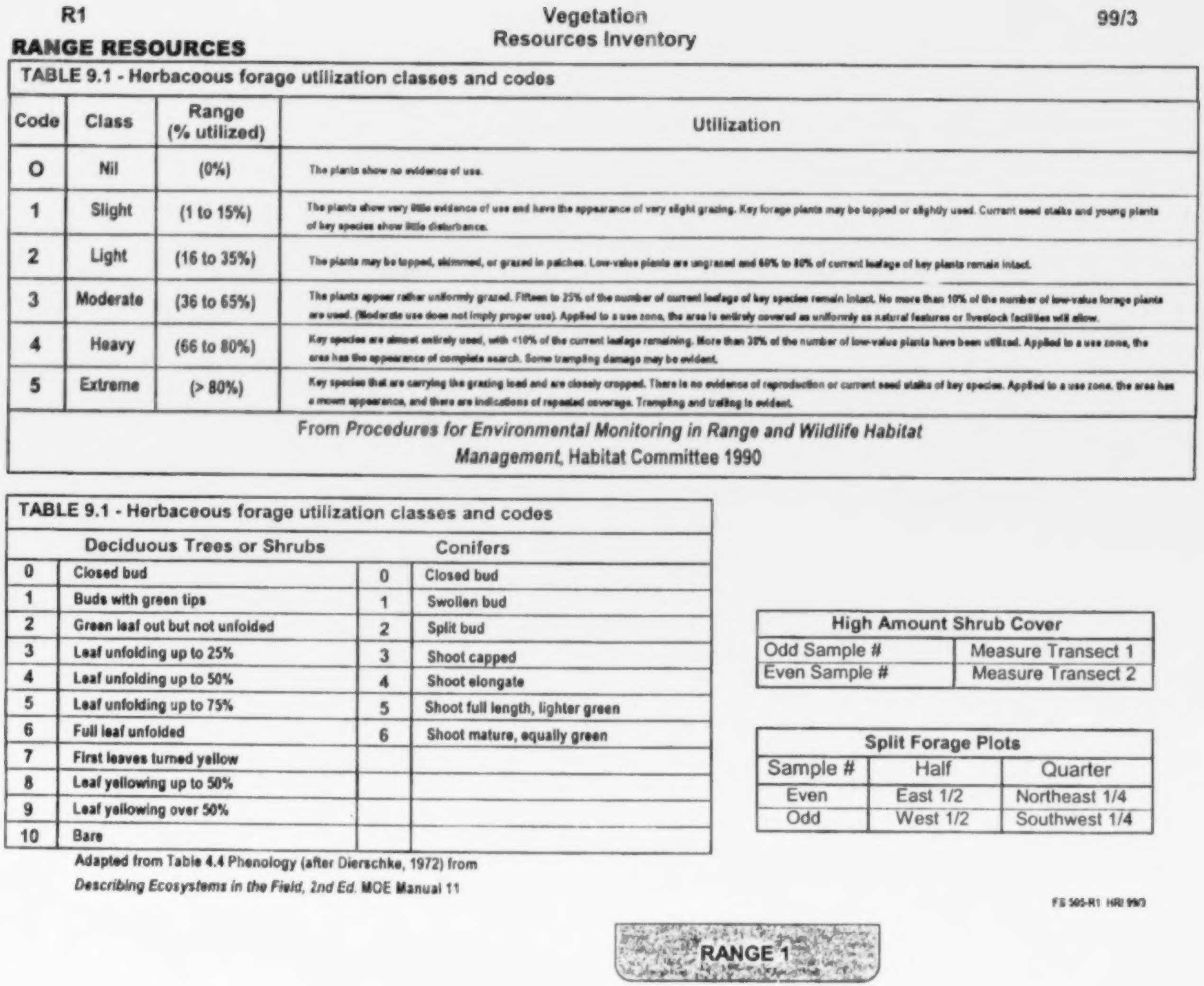
FS505-T16 HRI 99/3

Tree Identification Key: Native Broadleaves

Selected key characters to differentiate native broadleaf tree species of British Columbia

Alder (*Alnus*)	**leaves oval-shaped; fruiting catkin cone-like, hardened and persistent after release of nutlets**
A. rubra	to 24 m tall; leaves elliptic, tips pointed, base somewhat pointed, bright green above, greyish underneath and not hairy; leaf margins bluntly double-toothed, tending to curl under.
Apple (*Malus*)	
M. fusca	to 12 m tall, often shrub-like; bark deeply fissured with age; branches armed with sharp shoots; showy white flowers, fragrant, petals to 15 mm long; leaves lance- to egg-shaped, to 10 cm long, pointed, toothed along irregular lobes; fruits yellow to purplish-red apples, 10-15 mm across.
Aspen/Poplar (*Populus*)	
P. balsamifera	to 50 m tall; crown narrow and columnar; bark furrowed with age; buds resinous, fragrant; leaf stalks rounded; leaves triangular to heart-shaped with pointed tips, margins finely toothed.
P. b. ssp. *balsamifera*	to 25 m tall; fruits with 2 carpels; northern and northeastern BC.
P. b. ssp. *trichocarpa*	to 40 m tall; fruits with 3 carpels; throughout BC except northeast.
P. tremuloides	to 30 m tall; crown short and rounded; bark smooth, sometimes furrowed with age, but only near base of stem; buds shiny, not resinous; leaf stalks strongly flattened; leaves round to triangular, with pointed tip, margins irregularly round-toothed.
Arbutus (Arbutus)	
A. menziesii	to 30 m tall; young bark greenish to cinnamon-red and smooth, older bark dark brownish-red and peeling; leaves evergreen, oval, to 15 cm long; flowers white, urn-shaped, in clusters, fragrant; fruits orange-red berries.
Birch (*Betula*)	**often multi-stemmed; leaves egg-shaped to triangular; fruiting catkin cylindrical, falling after release of nutlets**
B. neoalaskana	to 15 m tall; bark thin and papery, sometimes peeling, brownish to white; twigs glabrous, covered with resin-glands; leaves broadly triangular, glabrous; leaf petioles 15-30 mm long; northeastern BC.
B. x winteri	intergrades between *B. neoalaskana* and *B. papyrifera*; characteristics variable.
B. papyrifera	to 35 m tall; bark peeling in papery strips, brownish to white; twigs pubescent; leaves oval to diamond-shaped with pointed tips, glandular and hairy beneath, becoming glabrous with tufts of hair remaining in the vein axils, margins coarse, irregular, double-toothed; leaf stalks 15 mm.
B. occidentalis	to 10 m tall, often shrubby; bark smooth and thin, not peeling, shiny reddish brown; twigs with wart-like crystalline glands; leaves egg-shaped, broadest below, pointed at tip, yellowish green above, pale and dotted with fine glands below, margins double-toothed; leaf stalks 5-15 mm.
Cascara (*Rhamnus*)	
R. purshiana	to 12 m tall; bark thin, dark greyish-brown, smooth when young, scaly with age; inner bark bright yellow, turning dark brown on exposure; leaves elliptic, 6-18 cm long, finely toothed, prominently parallel veined; flowers greenish; fruits purplish-black berries.
Cherry (*Prunus*)	
P. emarginata	to 15 m tall; bark reddish-brown or grey, with rows of raised horizontal pores; leaves oblong to oval, 3-8 cm long, rounded at tip, margins finely toothed; 5-10 flowers and fruits in flat-topped cluster; fruits bright red cherries, 5-12 mm across, bitter.
P. pensylvanica	to 12 m tall; bark dark reddish-brown with rows of raised horizontal pores, peeling in strips; leaves lance-shaped, 7-10 cm long, gradually tapering to long pointed tip, margins finely round-toothed; 5-7 flowers and fruits in flat-topped cluster; flowers small and white; fruits bright red cherries, 5 mm across, sour.
P. virginiana	to 10 m tall, often shrubby; bark smooth, dark reddish to greyish brown, without rows of raised pores; leaves broadly oval, 5-10 cm long, tapering at both ends, tips pointed, margins finely sharp-toothed; 10 flowers and fruits in elongate cluster; flowers white and small; fruits shiny, dark red to purple or black cherries, 15 mm across, astringent.
Dogwood (*Cornus*)	
C. nuttallii	to 20 m tall; bark smooth, grey, scaly with age; leaves opposite, oval, to 10 cm long, sharp-pointed at tip, tapering to base, prominent veins curving parallel to leaf edges; flowers inconspicuous in tight cluster, surrounded by 4-6 large, showy white bracts; fruits clusters of bright red "berries," to 1 cm across.
Maple (*Acer*)	
A. macrophyllum	to 35 m tall; stems green and smooth, turning grey-brown and ridged with age; leaves opposite, 5-lobed, 15-30 cm across; flowers greenish-yellow, numerous in a hanging cylindrical cluster appearing with or before the leaves; samara wings spread in V-shape, bristly yellowish hairs on nutlet.
Oak (*Quercus*)	
Q. garryana	to 25 m tall; bark light grey, thick furrows and ridges; leaves deeply round-lobed, to 12 cm long; fruits acorns, 2-3 cm long, stalkless.

Figure B.16 — Field Guide T-16 Tree Identification Key – Native Broadleaves.



R1

RANGE RESOURCES

Vegetation
Resources Inventory

99/3

TABLE 9.1 - Herbaceous forage utilization classes and codes

Code	Class	Range (% utilized)	Utilization
O	Nil	(0%)	The plants show no evidence of use.
1	Slight	(1 to 15%)	The plants show very little evidence of use and have the appearance of very slight grazing. Key forage plants may be topped or slightly used. Current seed stalks and young plants of key species show little disturbance.
2	Light	(16 to 35%)	The plants may be topped, skimmed, or grazed in patches. Low-value plants are ungrazed and 60% to 80% of current leafage of key plants remain intact.
3	Moderate	(36 to 65%)	The plants appear rather uniformly grazed. Fifteen to 25% of the number of current leafage of key species remain intact. No more than 10% of the number of low-value forage plants are used. (Moderate use does not imply proper use). Applied to a use zone, the area is entirely covered as uniformly as natural features or livestock facilities will allow.
4	Heavy	(66 to 80%)	Key species are almost entirely used, with <10% of the current leafage remaining. More than 30% of the number of low-value plants have been utilized. Applied to a use zone, the area has the appearance of complete search. Some trampling damage may be evident.
5	Extreme	(> 80%)	Key species that are carrying the grazing load and are closely cropped. There is no evidence of reproduction or current seed stalks of key species. Applied to a use zone, the area has a mown appearance, and there are indications of repeated coverage. Trampling and trailing is evident.

From *Procedures for Environmental Monitoring in Range and Wildlife Habitat Management*, Habitat Committee 1990

TABLE 9.1 - Herbaceous forage utilization classes and codes

	Deciduous Trees or Shrubs		Conifers
0	Closed bud	0	Closed bud
1	Buds with green tips	1	Swollen bud
2	Green leaf out but not unfolded	2	Split bud
3	Leaf unfolding up to 25%	3	Shoot capped
4	Leaf unfolding up to 50%	4	Shoot elongate
5	Leaf unfolding up to 75%	5	Shoot full length, lighter green
6	Full leaf unfolded	6	Shoot mature, equally green
7	First leaves turned yellow		
8	Leaf yellowing up to 50%		
9	Leaf yellowing over 50%		
10	Bare		

Adapted from Table 4.4 Phenology (after Dierschke, 1972) from
Describing Ecosystems in the Field, 2nd Ed. MOE Manual 11

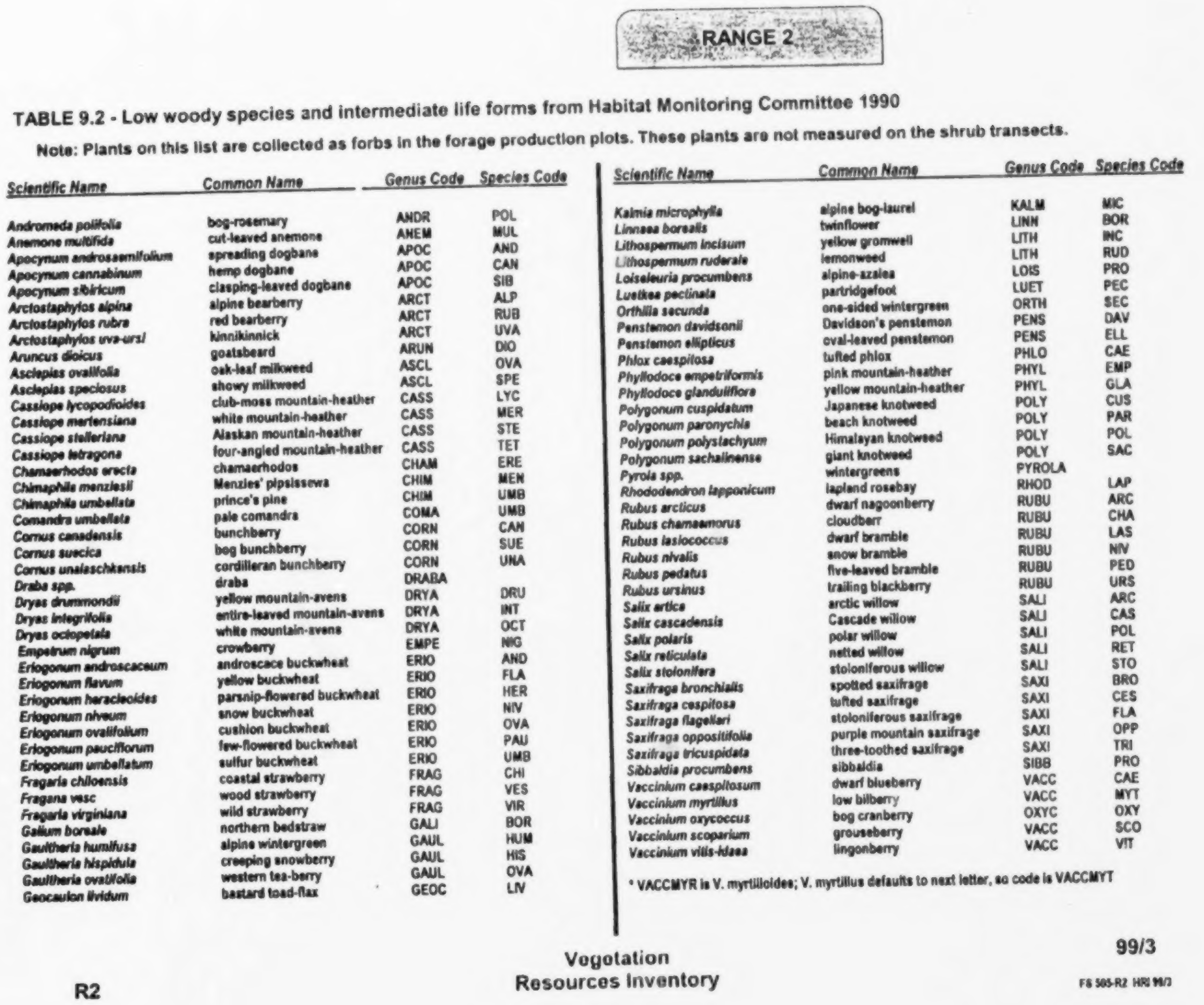
High Amount Shrub Cover	
Odd Sample #	Measure Transect 1
Even Sample #	Measure Transect 2

Split Forage Plots		
Sample #	Half	Quarter
Even	East 1/2	Northeast 1/4
Odd	West 1/2	Southwest 1/4

FS 505-R1 HRI 99/3

RANGE 1

Figure B.17 — Field Guide R-1 Range Resources: Range Utilization Classes, Phenology Codes, Split Plot Procedures.



RANGE 2

TABLE 9.2 - Low woody species and intermediate life forms from Habitat Monitoring Committee 1990

Note: Plants on this list are collected as forbs in the forage production plots. These plants are not measured on the shrub transects.

Scientific Name	Common Name	Genus Code	Species Code
Andromeda polifolia	bog-rosemary	ANDR	POL
Anemone multifida	cut-leaved anemone	ANEM	MUL
Apocynum androsaemifolium	spreading dogbane	APOC	AND
Apocynum cannabinum	hemp dogbane	APOC	CAN
Apocynum sibiricum	clasping-leaved dogbane	APOC	SIB
Arctostaphylos alpina	alpine bearberry	ARCT	ALP
Arctostaphylos rubra	red bearberry	ARCT	RUB
Arctostaphylos uva-ursi	kinnikinnick	ARCT	UVA
Aruncus dioicus	goatsbeard	ARUN	DIO
Asclepias ovalifolia	oak-leaf milkweed	ASCL	OVA
Asclepias speciosus	showy milkweed	ASCL	SPE
Cassiope lycopodioides	club-moss mountain-heather	CASS	LYC
Cassiope mertensiana	white mountain-heather	CASS	MER
Cassiope stelleriana	Alaskan mountain-heather	CASS	STE
Cassiope tetragona	four-angled mountain-heather	CASS	TET
Chamaerhodos erecta	chamaerhodos	CHAM	ERE
Chimaphila menziesii	Menzies' pipsissewa	CHIM	MEN
Chimaphila umbellata	prince's pine	CHIM	UMB
Comandra umbellata	pale comandra	COMA	UMB
Cornus canadensis	bunchberry	CORN	CAN
Cornus suecica	bog bunchberry	CORN	SUE
Cornus unalaschkensis	cordilleran bunchberry	CORN	UNA
Draba spp.	draba	DRABA	
Dryas drummondii	yellow mountain-avens	DRYA	DRU
Dryas integrifolia	entire-leaved mountain-avens	DRYA	INT
Dryas octopetala	white mountain-avens	DRYA	OCT
Empetrum nigrum	crowberry	EMPE	NIG
Eriogonum androscaceum	androscace buckwheat	ERIO	AND
Eriogonum flavum	yellow buckwheat	ERIO	FLA
Eriogonum heracleoides	parsnip-flowered buckwheat	ERIO	HER
Eriogonum niveum	snow buckwheat	ERIO	NIV
Eriogonum ovalifolium	cushion buckwheat	ERIO	OVA
Eriogonum pauciflorum	few-flowered buckwheat	ERIO	PAU
Eriogonum umbellatum	sulfur buckwheat	ERIO	UMB
Fragaria chiloensis	coastal strawberry	FRAG	CHI
Fragaria vesc	wood strawberry	FRAG	VES
Fragaria virginiana	wild strawberry	FRAG	VIR
Galium boreale	northern bedstraw	GALI	BOR
Gaultheria humifusa	alpine wintergreen	GAUL	HUM
Gaultheria hispidula	creeping snowberry	GAUL	HIS
Gaultheria ovatifolia	western tea-berry	GAUL	OVA
Geocaulon lividum	bastard toad-flax	GEOC	LIV
Kalmia microphylla	alpine bog-laurel	KALM	MIC
Linnaea borealis	twinflower	LINN	BOR
Lithospermum incisum	yellow gromwell	LITH	INC
Lithospermum ruderale	lemonweed	LITH	RUD
Loiseleuria procumbens	alpine-azalea	LOIS	PRO
Luetkea pectinata	partridgefoot	LUET	PEC
Orthilia secunda	one-sided wintergreen	ORTH	SEC
Penstemon davidsonii	Davidson's penstemon	PENS	DAV
Penstemon ellipticus	oval-leaved penstemon	PENS	ELL
Phlox caespitosa	tufted phlox	PHLO	CAE
Phyllodoce empetriformis	pink mountain-heather	PHYL	EMP
Phyllodoce glanduliflora	yellow mountain-heather	PHYL	GLA
Polygonum cuspidatum	Japanese knotweed	POLY	CUS
Polygonum paronychia	beach knotweed	POLY	PAR
Polygonum polystachyum	Himalayan knotweed	POLY	POL
Polygonum sachalinense	giant knotweed	POLY	SAC
Pyrola spp.	wintergreens	PYROLA	
Rhododendron lapponicum	lapland rosebay	RHOD	LAP
Rubus arcticus	dwarf nagoonberry	RUBU	ARC
Rubus chamaemorus	cloudberr	RUBU	CHA
Rubus lasiococcus	dwarf bramble	RUBU	LAS
Rubus nivalis	snow bramble	RUBU	NIV
Rubus pedatus	five-leaved bramble	RUBU	PED
Rubus ursinus	trailing blackberry	RUBU	URS
Salix artica	arctic willow	SALI	ARC
Salix cascadensis	Cascade willow	SALI	CAS
Salix polaris	polar willow	SALI	POL
Salix reticulata	netted willow	SALI	RET
Salix stolonifera	stoloniferous willow	SALI	STO
Saxifraga bronchialis	spotted saxifrage	SAXI	BRO
Saxifraga cespitosa	tufted saxifrage	SAXI	CES
Saxifraga flagellari	stoloniferous saxifrage	SAXI	FLA
Saxifraga oppositifolia	purple mountain saxifrage	SAXI	OPP
Saxifraga tricuspidata	three-toothed saxifrage	SAXI	TRI
Sibbaldia procumbens	sibbaldia	SIBB	PRO
Vaccinium caespitosum	dwarf blueberry	VACC	CAE
Vaccinium myrtillus	low bilberry	VACC	MYT
Vaccinium oxycoccus	bog cranberry	OXYC	OXY
Vaccinium scoparium	grouseberry	VACC	SCO
Vaccinium vitis-idaea	lingonberry	VACC	VIT

* VACCMYR is V. myrtilloides; V. myrtillus defaults to next letter, so code is VACCMYT

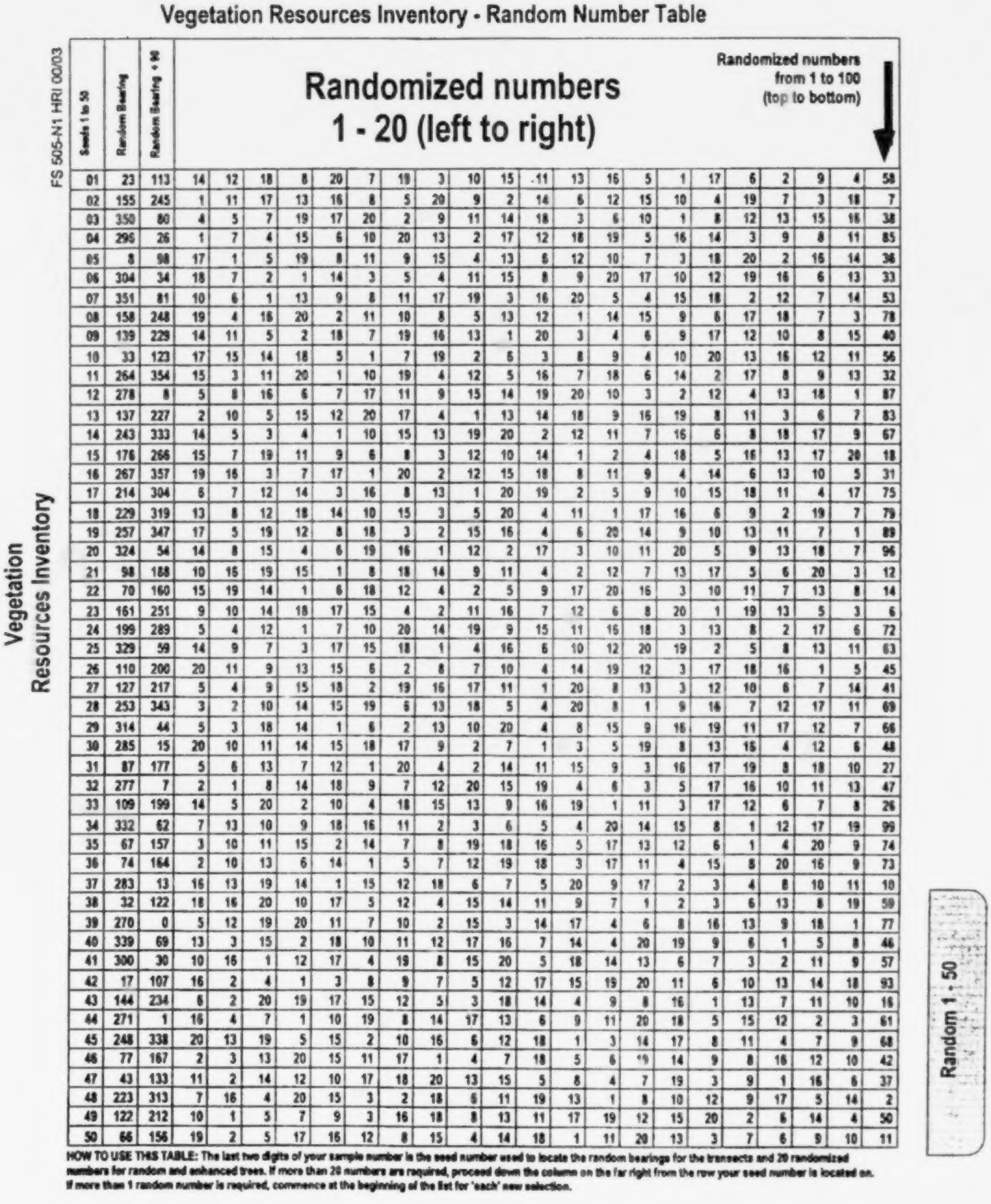
R2

Vegetation
Resources Inventory

99/3

FS 505-R2 HRI 99/3

Figure B.18 — Field Guide R-2 Range Resources: Low Woody Species and Intermediate Life Forms.



Vegetation Resources Inventory - Random Number Table

FS 505-N1 HRI 00/03

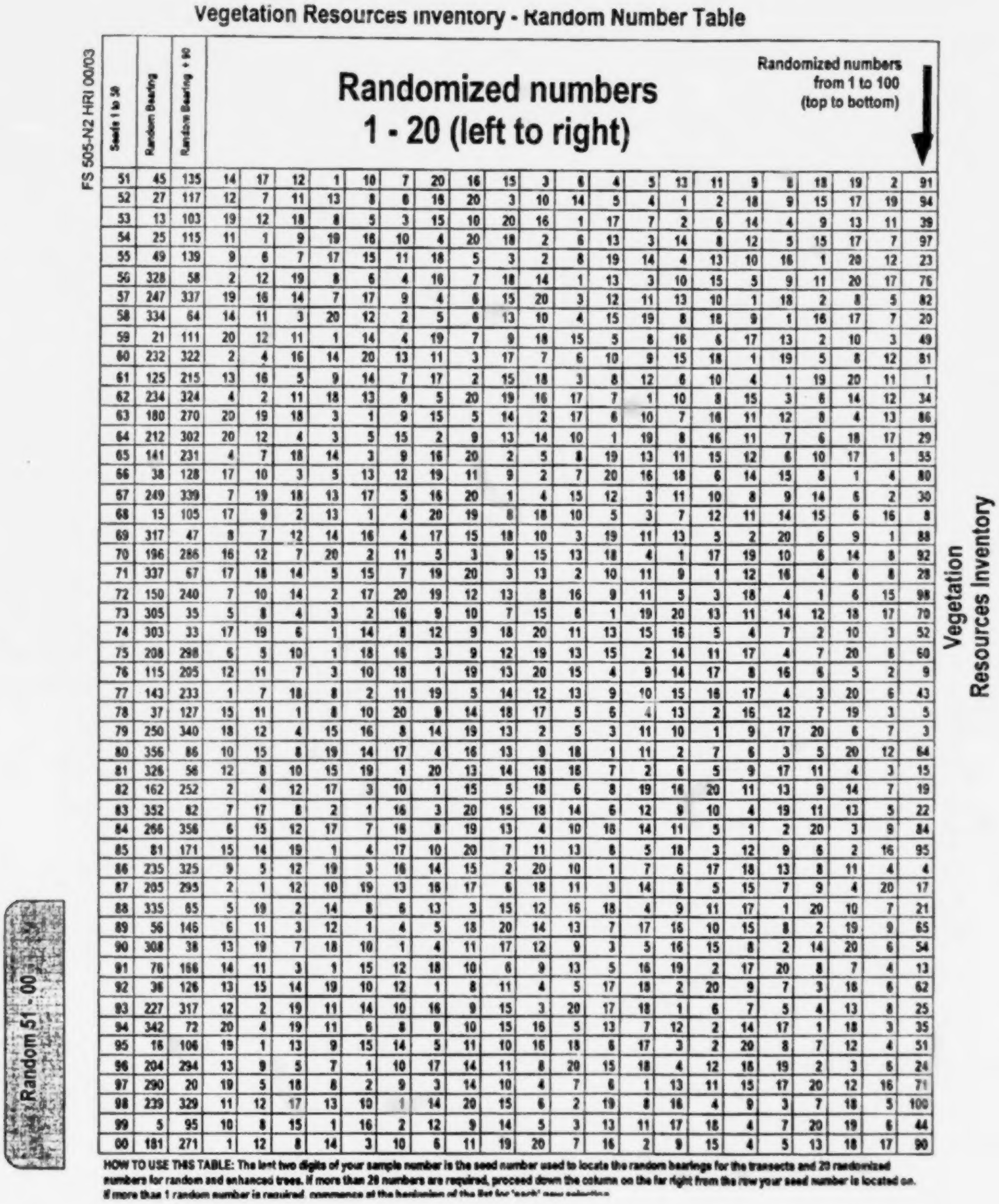
Vegetation Resources Inventory

Seeds 1 to 50	Random Bearing	Random Bearing + 90	Randomized numbers 1 - 20 (left to right)																				Randomized numbers from 1 to 100 (top to bottom)
01	23	113	14	12	18	8	20	7	19	3	10	15	11	13	16	5	1	17	6	2	9	4	58
02	155	245	1	11	17	13	16	8	5	20	9	2	14	6	12	15	10	4	19	7	3	18	7
03	350	80	4	5	7	19	17	20	2	9	11	14	18	3	6	10	1	8	12	13	15	16	38
04	295	26	1	7	4	15	6	10	20	13	2	17	12	18	19	5	16	14	3	9	8	11	85
05	8	98	17	1	5	19	8	11	9	15	4	13	6	12	10	7	3	18	20	2	16	14	36
06	304	34	18	7	2	1	14	3	5	4	11	15	8	9	20	17	10	12	19	16	6	13	33
07	351	81	10	6	1	13	9	8	11	17	19	3	16	20	5	4	15	18	2	12	7	14	53
08	158	248	19	4	16	20	2	11	10	8	5	13	12	1	14	15	9	6	17	18	7	3	78
09	139	229	14	11	5	2	18	7	19	16	13	1	20	3	4	6	9	17	12	10	8	15	40
10	33	123	17	15	14	18	5	1	7	19	2	6	3	8	9	4	10	20	13	16	12	11	56
11	264	354	15	3	11	20	1	10	19	4	12	5	16	7	18	6	14	2	17	8	9	13	32
12	278	8	5	8	16	6	7	17	11	9	15	14	19	20	10	3	2	12	4	13	18	1	87
13	137	227	2	10	5	15	12	20	17	4	1	13	14	18	9	16	19	8	11	3	6	7	83
14	243	333	14	5	3	4	1	10	15	13	19	20	2	12	11	7	16	6	8	18	17	9	67
15	176	266	15	7	19	11	9	6	8	3	12	10	14	1	2	4	18	5	16	13	17	20	18
16	267	357	19	16	3	7	17	1	20	2	12	15	18	8	11	9	4	14	6	13	10	5	31
17	214	304	6	7	12	14	3	16	8	13	1	20	19	2	5	9	10	15	18	11	4	17	75
18	229	319	13	8	12	18	14	10	15	3	5	20	4	11	1	17	16	6	9	2	19	7	79
19	257	347	17	5	19	12	8	18	3	2	15	16	4	6	20	14	9	10	13	11	7	1	89
20	324	54	14	8	15	4	6	19	16	1	12	2	17	3	10	11	20	5	9	13	18	7	96
21	98	188	10	16	19	15	1	8	18	14	9	11	4	2	12	7	13	17	5	6	20	3	12
22	70	160	15	19	14	1	6	18	12	4	2	5	9	17	20	16	3	10	11	7	13	8	14
23	161	251	9	10	14	18	17	15	4	2	11	16	7	12	6	8	20	1	19	13	5	3	6
24	199	289	5	4	12	1	7	10	20	14	19	9	15	11	16	18	3	13	8	2	17	6	72
25	329	59	14	9	7	3	17	15	18	1	4	16	6	10	12	20	19	2	5	8	13	11	63
26	110	200	20	11	9	13	15	6	2	8	7	10	4	14	19	12	3	17	18	16	1	5	45
27	127	217	5	4	9	15	18	2	19	16	17	11	1	20	8	13	3	12	10	6	7	14	41
28	253	343	3	2	10	14	15	19	6	13	18	5	4	20	8	1	9	16	7	12	17	11	69
29	314	44	5	3	18	14	1	6	2	13	10	20	4	8	15	9	16	19	11	17	12	7	66
30	285	15	20	10	11	14	15	18	17	9	2	7	1	3	5	19	8	13	16	4	12	6	48
31	87	177	5	6	13	7	12	1	20	4	2	14	11	15	9	3	16	17	19	8	18	10	27
32	277	7	2	1	8	14	18	9	7	12	20	15	19	4	6	3	5	17	16	10	11	13	47
33	109	199	14	5	20	2	10	4	18	15	13	9	16	19	1	11	3	17	12	6	7	8	26
34	332	62	7	13	10	9	18	16	11	2	3	6	5	4	20	14	15	8	1	12	17	19	99
35	67	157	3	10	11	15	2	14	7	8	19	18	16	5	17	13	12	6	1	4	20	9	74
36	74	164	2	10	13	6	14	1	5	7	12	19	18	3	17	11	4	15	8	20	16	9	73
37	283	13	16	13	19	14	1	15	12	18	6	7	5	20	9	17	2	3	4	8	10	11	10
38	32	122	18	16	20	10	17	5	12	4	15	14	11	9	7	1	2	3	6	13	8	19	59
39	270	0	5	12	19	20	11	7	10	2	15	3	14	17	4	6	8	16	13	9	18	1	77
40	339	69	13	3	15	2	18	10	11	12	17	16	7	14	4	20	19	9	6	1	5	8	46
41	300	30	10	16	1	12	17	4	19	8	15	20	5	18	14	13	6	7	3	2	11	9	57
42	17	107	16	2	4	1	3	8	9	7	5	12	17	15	19	20	11	6	10	13	14	18	93
43	144	234	6	2	20	19	17	15	12	5	3	18	14	4	9	8	16	1	13	7	11	10	16
44	271	1	16	4	7	1	10	19	8	14	17	13	6	9	11	20	18	5	15	12	2	3	61
45	248	338	20	13	19	5	15	2	10	16	6	12	18	1	3	14	17	8	11	4	7	9	68
46	77	167	2	3	13	20	15	11	17	1	4	7	18	5	6	19	14	9	8	16	12	10	42
47	43	133	11	2	14	12	10	17	18	20	13	15	5	8	4	7	19	3	9	1	16	6	37
48	223	313	7	16	4	20	15	3	2	18	6	11	19	13	1	8	10	12	9	17	5	14	2
49	122	212	10	1	5	7	9	3	16	18	8	13	11	17	19	12	15	20	2	6	14	4	50
50	66	156	19	2	5	17	16	12	8	15	4	14	18	1	11	20	13	3	7	6	9	10	11

HOW TO USE THIS TABLE: The last two digits of your sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, commence at the beginning of the list for 'each' new selection.

Random 1 - 50

Figure B.19 — Field Guide N-1 Random numbers for samples ending in 01–50.



Vegetation Resources Inventory - Random Number Table

FS 505-N2 HRI 00/03

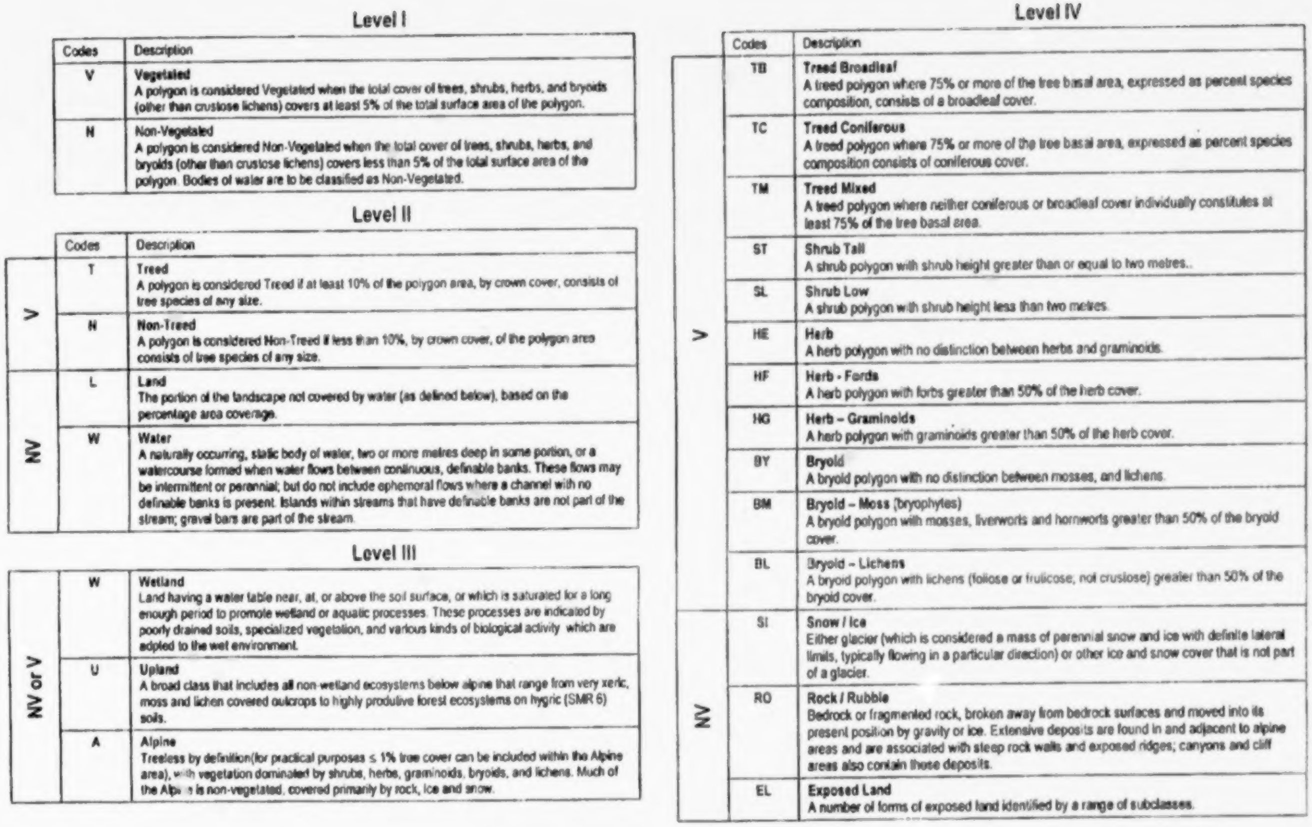
Seeds 1 to 50	Random Bearing	Random Bearing + 90	Randomized numbers 1 - 20 (left to right)																				Randomized numbers from 1 to 100 (top to bottom)
51	45	135	14	17	12	1	10	7	20	16	15	3	6	4	5	13	11	9	8	18	19	2	91
52	27	117	12	7	11	13	8	6	16	20	3	10	14	5	4	1	2	18	9	15	17	19	94
53	13	103	19	12	18	8	5	3	15	10	20	16	1	17	7	2	6	14	4	9	13	11	39
54	25	115	11	1	9	19	16	10	4	20	18	2	6	13	3	14	8	12	5	15	17	7	97
55	49	139	9	6	7	17	15	11	18	5	3	2	8	19	14	4	13	10	16	1	20	12	23
56	328	58	2	12	19	8	6	4	16	7	18	14	1	13	3	10	15	5	9	11	20	17	76
57	247	337	19	16	14	7	17	9	4	6	15	20	3	12	11	13	10	1	18	2	8	5	82
58	334	64	14	11	3	20	12	2	5	6	13	10	4	15	19	8	18	9	1	16	17	7	20
59	21	111	20	12	11	1	14	4	19	7	9	18	15	5	8	16	6	17	13	2	10	3	49
60	232	322	2	4	16	14	20	13	11	3	17	7	6	10	9	15	18	1	19	5	8	12	81
61	125	215	13	16	5	9	14	7	17	2	15	18	3	8	12	6	10	4	1	19	20	11	1
62	234	324	4	2	11	18	13	9	5	20	19	16	17	7	1	10	8	15	3	6	14	12	34
63	180	270	20	19	18	3	1	9	15	5	14	2	17	6	10	7	16	11	12	8	4	13	86
64	212	302	20	12	4	3	5	15	2	9	13	14	10	1	19	8	16	11	7	6	18	17	29
65	141	231	4	7	18	14	3	9	16	20	2	5	8	19	13	11	15	12	6	10	17	1	55
66	38	128	17	10	3	5	13	12	19	11	9	2	7	20	16	18	6	14	15	8	1	4	80
67	249	339	7	19	18	13	17	5	16	20	1	4	15	12	3	11	10	8	9	14	6	2	30
68	15	105	17	9	2	13	1	4	20	19	8	18	10	5	3	7	12	11	14	15	6	16	8
69	317	47	8	7	12	14	16	4	17	15	18	10	3	19	11	13	5	2	20	6	9	1	88
70	196	286	16	12	7	20	2	11	5	3	9	15	13	18	4	1	17	19	10	6	14	8	92
71	337	67	17	18	14	5	15	7	19	20	3	13	2	10	11	9	1	12	16	4	6	8	28
72	150	240	7	10	14	2	17	20	19	12	13	8	16	9	11	5	3	18	4	1	6	15	98
73	305	35	5	8	4	3	2	16	9	10	7	15	6	1	19	20	13	11	14	12	18	17	70
74	303	33	17	19	6	1	14	8	12	9	18	20	11	13	15	16	5	4	7	2	10	3	52
75	208	298	6	5	10	1	18	16	3	9	12	19	13	15	2	14	11	17	4	7	20	8	60
76	115	205	12	11	7	3	10	18	1	19	13	20	15	4	9	14	17	8	16	6	5	2	9
77	143	233	1	7	18	8	2	11	19	5	14	12	13	9	10	15	16	17	4	3	20	6	43
78	37	127	15	11	1	8	10	20	9	14	18	17	5	6	4	13	2	16	12	7	19	3	5
79	250	340	18	12	4	15	16	8	14	19	13	2	5	3	11	10	1	9	17	20	6	7	3
80	356	86	10	15	8	19	14	17	4	16	13	9	18	1	11	2	7	6	3	5	20	12	64
81	326	56	12	8	10	15	19	1	20	13	14	18	16	7	2	6	5	9	17	11	4	3	15
82	162	252	2	4	12	17	3	10	1	15	5	18	6	8	19	16	20	11	13	9	14	7	19
83	352	82	7	17	8	2	1	16	3	20	15	18	14	6	12	9	10	4	19	11	13	5	22
84	266	356	6	15	12	17	7	16	8	19	13	4	10	18	14	11	5	1	2	20	3	9	84
85	81	171	15	14	19	1	4	17	10	20	7	11	13	8	5	18	3	12	9	6	2	16	95
86	235	325	9	5	12	19	3	16	14	15	2	20	10	1	7	6	17	18	13	8	11	4	4
87	205	295	2	1	12	10	19	13	16	17	6	18	11	3	14	8	5	15	7	9	4	20	17
88	335	65	5	19	2	14	8	6	13	3	15	12	16	18	4	9	11	17	1	20	10	7	21
89	56	146	6	11	3	12	1	4	5	18	20	14	13	7	17	16	10	15	8	2	19	9	65
90	308	38	13	19	7	18	10	1	4	11	17	12	9	3	5	16	15	8	2	14	20	6	54
91	76	166	14	11	3	1	15	12	18	10	6	9	13	5	16	19	2	17	20	8	7	4	13
92	36	126	13	15	14	19	10	12	1	8	11	4	5	17	18	2	20	9	7	3	16	6	62
93	227	317	12	2	19	11	14	10	16	9	15	3	20	17	18	1	6	7	5	4	13	8	25
94	342	72	20	4	19	11	6	8	9	10	15	16	5	13	7	12	2	14	17	1	18	3	35
95	16	106	19	1	13	9	15	14	5	11	10	16	18	6	17	3	2	20	8	7	12	4	51
96	204	294	13	9	5	7	1	10	17	14	11	8	20	15	18	4	12	16	19	2	3	6	24
97	290	20	19	5	18	8	2	9	3	14	10	4	7	6	1	13	11	15	17	20	12	16	71
98	239	329	11	12	17	13	10	1	14	20	15	6	2	19	8	16	4	9	3	7	18	5	100
99	5	95	10	8	15	1	16	2	12	9	14	5	3	13	11	17	18	4	7	20	19	6	44
00	181	271	1	12	8	14	3	10	6	11	19	20	7	16	2	9	15	4	5	13	18	17	90

HOW TO USE THIS TABLE: The last two digits of your sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required commence at the beginning of the list for 'each' new selection.

Random 51 - 00

Vegetation Resources Inventory

Figure B.20 — Field Guide N-2 Random numbers for samples ending in 51–100.



Level I

Codes	Description
V	**Vegetated** A polygon is considered Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers at least 5% of the total surface area of the polygon.
N	Non-Vegetated A polygon is considered Non-Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers less than 5% of the total surface area of the polygon. Bodies of water are to be classified as Non-Vegetated.

Level II

	Codes	Description
V	T	**Treed** A polygon is considered Treed if at least 10% of the polygon area, by crown cover, consists of tree species of any size.
	N	**Non-Treed** A polygon is considered Non-Treed if less than 10%, by crown cover, of the polygon area consists of tree species of any size.
NV	L	**Land** The portion of the landscape not covered by water (as defined below), based on the percentage area coverage.
	W	**Water** A naturally occurring, static body of water, two or more metres deep in some portion, or a watercourse formed when water flows between continuous, definable banks. These flows may be intermittent or perennial; but do not include ephemoral flows where a channel with no definable banks is present. Islands within streams that have definable banks are not part of the stream; gravel bars are part of the stream.

Level III

NV or V	W	**Wetland** Land having a water table near, at, or above the soil surface, or which is saturated for a long enough period to promote wetland or aquatic processes. These processes are indicated by poorly drained soils, specialized vegetation, and various kinds of biological activity which are adpted to the wet environment.
	U	**Upland** A broad class that includes all non-wetland ecosystems below alpine that range from very xeric, moss and lichen covered outcrops to highly produtive forest ecosystems on hygric (SMR 6) soils.
	A	**Alpine** Treeless by definition(for practical purposes ≤ 1% tree cover can be included within the Alpine area), with vegetation dominated by shrubs, herbs, graminoids, bryoids, and lichens. Much of the Alpine is non-vegetated, covered primarily by rock, ice and snow.

Level IV

	Codes	Description
V	TB	**Treed Broadleaf** A treed polygon where 75% or more of the tree basal area, expressed as percent species composition, consists of a broadleaf cover.
	TC	**Treed Coniferous** A treed polygon where 75% or more of the tree basal area, expressed as percent species composition consists of coniferous cover.
	TM	**Treed Mixed** A treed polygon where neither coniferous or broadleaf cover individually constitutes at least 75% of the tree basal area.
	ST	**Shrub Tall** A shrub polygon with shrub height greater than or equal to two metres..
	SL	**Shrub Low** A shrub polygon with shrub height less than two metres.
	HE	**Herb** A herb polygon with no distinction between herbs and graminoids.
	HF	**Herb - Fords** A herb polygon with forbs greater than 50% of the herb cover.
	HG	**Herb – Graminoids** A herb polygon with graminoids greater than 50% of the herb cover.
	BY	**Bryoid** A bryoid polygon with no distinction between mosses, and lichens.
	BM	**Bryoid – Moss** (bryophytes) A bryoid polygon with mosses, liverworts and hornworts greater than 50% of the bryoid cover.
	BL	**Bryoid – Lichens** A bryoid polygon with lichens (foliose or fruticose; not crustose) greater than 50% of the bryoid cover.
NV	SI	**Snow / Ice** Either glacier (which is considered a mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction) or other ice and snow cover that is not part of a glacier.
	RO	**Rock / Rubble** Bedrock or fragmented rock, broken away from bedrock surfaces and moved into its present position by gravity or ice. Extensive deposits are found in and adjacent to alpine areas and are associated with steep rock walls and exposed ridges; canyons and cliff areas also contain those deposits.
	EL	**Exposed Land** A number of forms of exposed land identified by a range of subclasses.

LCC CODES

Figure B.21 — Field Guide E-1 B.C. Land Cover Classification Scheme Codes – Levels I to IV.

LCC CODES

Level V

	Codes	Description
V	DE	**Dense** Tree, shrub or herb cover that is between 61 and 100% for the polygon.
	OP	**Open** Tree, shrub or herb cover that is between 26 and 60% for the polygon. For bryoid polygons, the cover of bryoids is less than or equal to 50% of the polygon.
	SP	**Sparse** Cover is between 10 and 25% for the treed polygon or cover is between 20% and 25% for shrub or herb polygons.
	CL	**Closed** For bryoid polygons, the cover of bryoids is greater than 50% of the polygon.
NV - Snow/Ice	GL	**Glacier** A mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction.
	SC	**Snow Cover** Snow or ice that is not part of a glacier but is found during summer months on the landscape.
NV - Rock/Rubble	BR	**Bedrock** Unfragmented, consolidated rock; contiguous with underlying material.
	RT	**Rubble, Talus, Blockfield** Fragmented rock, broken away from bedrock surfaces and moved into present position by gravity or ice.
	MS	**Rubbly Mine Spoils** Discarded overburden or waste rock, moved to extract ore during mining.
	LB	**Lava Bed** An area where molten rock has flowed from a volcano or fissure and cooled to form solidified rock.
NV - Exposed Land	RS	**River Sediments** Silt, gravel and sand bars associated with former river channels and present river edges.
	ES	**Exposed Soil** Any exposed soil not covered by other categories such as areas of recent disturbance that include mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way where vegetation cover is less than five percent
	LS	**Pond or Lake Sediments** Exposed sediments related to dried lakes or ponds
	RM	**Reservoir Margin** Land exposed by a drained or fluctuating reservoir. This is found above "normal" water levels and may consist of a range of substrates including gravel, cobbles, fine sediments, or bedrock.

NV - Exposed Land	BE	**Beach** An area with sorted sediments reworked in recent time by wave action which may be formed at the edge of fresh or salt water bodies
	LL	**Landing** A compacted area adjacent to a road used for the purpose of sorting and loading logs.
	BU	**Burned Area** Land showing evidence of recent burning, either natural or prescribed. Vegetation of less than five percent crown cover is present at the time of polygon description.
	RP	**Road Surface** An area cleared and compacted for transporting goods and services by vehicles. Older roads that are used infrequently or not at all may cease to be non-vegetated.
	MU	**Mudflat Sediment** Flat plane-like areas associated with lakes, ponds, rivers or streams-dominated by the textured sediments. They can be associated with freshwater or estuarine sources.
	CB	**Cutbank** Part of a road corridor created up slope of the road surface created by excavation into the hillside.
	MO	**Moraine** An area of debris transported and deposited by a glacier.
	GP	**Gravel Pit** An area exposed through the removal of sand and gravel.
	TS	**Tailings** An area containing the solid waste material produced in the mining and milling of ore.
	RR	**Railway** A roadbed with fixed rails which may contain single or multiple rail lines.
	BP	**Buildings and Parking** Buildings and associated developments such as roads and parking areas
	OT	**Other** A non-vegetated polygon where none of the above categories can be reliably chosen
NV - Water	LA	**Lake** A naturally occurring static body of water more than two metres deep in some portion. The boundary for the lake is the natural high water mark.
	RE	**Reservoir** An artificial basin affected by impoundment behind a man made structure such as a dam, berm, dyke, or wall.
	RI	**River / Stream** A water course formed when water flows between continuous, definable banks. Flow may be intermittent or perennial but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream while islands within a stream that have definable banks are not
	SW	**Salt Water** A naturally occurring body of water containing salt or generally considered to be salty.

Figure B.22 — Field Guide E-2 B.C. Land Cover Classification Scheme Codes – Level V.

Appendix C: The Change Monitoring Inventory Tree Code List

Version 4.3
Data Custodian: Director, Research Branch, B.C. Ministry of Forests

This section lists the common name, scientific name, and tree code for B.C. trees. Trees are defined as being woody, single stemmed, and capable of growing to greater than 10 m in height. The latest version of the tree species codes is available at the following web address: http://www.for.gov.bc.ca/research/becweb/standards-species.htm

NATIVE CONIFERS

Cedar	*Thuja*	C	
western redcedar	*Thuja plicata*		Cw
Cypress	*Chamaecyparis*	Y	
yellow-cedar	*C. nootkatensis*		Yc
Douglas-fir	*Pseudotsuga*	F	
Douglas-fir	*P. menziesii*		Fd
coastal Douglas-fir	*P. menziesii* var. *menziesii*		Fdc
interior Douglas-fir	*P. menziesii* var. *glauca*		Fdi
Fir (Balsam)	*Abies*	B	
amabilis fir	*A. amabilis*		Ba
grand fir	*A. grandis*		Bg
subalpine fir	*A. lasiocarpa*		Bl
Hemlock	*Tsuga*	H	
mountain hemlock	*T.mertensiana*		Hm
western hemlock	*T.heterophylla*		Hw
mountain x western hemlock hybrid	*T.mertensiana* x *heterophylla*		Hxm
Juniper	*Juniperus*	J	
Rocky Mtn. juniper	*J. scopulorum*		Jr
Larch	*Larix*	L	
alpine larch	*L. lyallii*		La
tamarack	*L. laricina*		Lt
western larch	*L. occidentalis*		Lw
Pine	*Pinus*	P	
jack pine	*P. banksiana*		Pj
limber pine	*P. flexilis*		Pf

lodgepole pine	*P. contorta*		Pl
lodgepole pine	*P. contorta* var. *latifolia*		Pli
lodgepole x jack pine hybrid	*P.* x *murraybanksiana*		Pxj
ponderosa pine	*P. ponderosa*		Py
shore pine	*P. contorta* var. *contorta*		Plc
western white pine	*P. monticola*		Pw
whitebark pine	*P. albicaulis*		Pa
Spruce	*Picea*	S	
black spruce	*P. mariana*		Sb
Engelmann spruce	*P. engelmannii*		Se
Sitka spruce	*P. sitchensis*		Ss
white spruce	*P. glauca*		Sw
spruce hybrid	*Picea* cross		Sx
Engelmann x white	*P. engelmannii* x *glauca*		Sxw
Sitka x white	*P.* x *lutzii*		Sxl
Sitka x unknown hybrid	*P. sitchensis* x ?		Sxs
Yew	*Taxus*	T	
western yew	*Taxus brevifolia*		Tw

NATIVE HARDWOODS

Alder	***Alnus***	**D**	
red alder	*A. rubra*		Dr
Apple	***Malus***	**U**	
Pacific crab apple	*Malus fusca*		Up
Aspen, Cottonwood or Poplar	***Populus***	**A**	
poplar	*P. balsamifera*		Ac
balsam poplar	*P. b.* ssp. *balsamifera*		Acb
black cottonwood	*P. b.* ssp. *trichocarpa*		Act
hybrid poplars	*P.* spp.		Ax
trembling aspen	*P. tremuloides*		At
Arbutus	***Arbutus***	**R**	
Arbutus	*Arbutus menziesii*		Ra
Birch	***Betula***	**E**	
Alaska paper birch	*B. neoalaskana*		Ea
Alaska x paper birch hybrid	*B.* x *winteri*		Exp
paper birch	*B. papyrifera*		Ep
water birch	*B. occidentalis*		Ew

Cascara	***Rhamnus***	**K**	
cascara	*R. purshiana*		Kc
Cherry	***Prunus***	**V**	
bitter cherry	*P. emarginata*		Vb
choke cherry	*P. virginiana*		Vv
pin cherry	*P. pensylvanica*		Vp
Dogwood	***Cornus***	**G**	
Pacific dogwood	*Cornus nuttallii*		Gp
Maple	***Acer***	**M**	
bigleaf maple	*A. macrophyllum*		Mb
vine maple	*A. circinatum*		Mv
Oak	***Quercus***	**Q**	
Garry oak	*Q. garryana*		Qg
Willow	***Salix* spp.**	**W**	
Bebb's willow	*S. bebbiana*		Wb
Pacific willow	*S. lucida*		Wp
peachleaf willow	*S. amygdaloides*		Wa
pussy willow	*S. discolor*		Wd
Scouler's willow	*S. scouleriana*		Ws
Sitka willow	*S. sitchensis*		Wt

UNKNOWNS

Unknown		X	
Unknown co			Xc
Unknown har			Xh

OTHERS

Other tree, not on list		Z	
Other conifer			Zc
Other hardwood			Zh

EXOTICS[1]

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[1] (*) Introduced species not known to occur on Crown Land, but requiring a code for database purposes, are indicated with an asterisk.

Apple	*Malus*	U	
apple	*Malus pumila*		Ua
Aspen, Cottonwood or Poplar	*Populus*	A	
*southern cottonwood	*P. deltoides*		Ad
Birch	*Betula*	E	
European birch	*B. pendula*		Ee
silver birch	*B. pubescens*		Es
*yellow birch	*B. alleghaniensis*		Ey
Cherry	*Prunus*	V	
sweetc herry	*P. avium*		Vs
Cypress	*Chamaecyparis*	Y	
*Port Orford-cedar	*C. lawsoniana*		Yp
Fir (Balsam)	*Abies*	B	
*balsam fir	*A. balsamea*		Bb
noble fir	*A. procera*		Bp
*Shasta red fir	A. magnifica var. shastensis		Bm
*white fir	A. concolor		Bc
Larch	*Larix*	L	
*Dahurian larch	*L. gmelinii*		Ld
Maple	*Acer*	M	
box elder	*A. negundo*		Me
*Norway maple	*A. platanoides*		Mn
*Sycamore maple	*A. pseudoplatanus*		Ms
Oak	*Quercus*	Q	
*English oak	*Q. robur*		Qe
*white oak	*Q. alba*		Qw
Other exotics			
*incense-cedar	Calocedrus decurrens		Oa
*giant sequoia	*Sequoiadendron giganteum*		Ob
*coast redwood	*Sequoia sempervirens*		Oc
European mountain-ash	*Sorbus aucuparia*		Od
Siberian elm	*Ulmus pumila*		Oe
common pear	*Pyrus communis*		Of
Oregon ash	*Fraxinus latifolia*		Og
*white ash	*Fraxinus americana*		Oh
*shagbark hickory	*Carya ovata*		Oi
Pine	*Pinus*	P	
*Monterey pine	*P. radiata*		Pm
*red pine	*P. resinosa*		Pr

	*sugar pine		*P. lambertiana*		Ps
Spruce		*Picea*		S	
	*Norway spruce		*P. abies*		Sn

Changes to Version 4 of B.C. Ministry of Forests Tree Code List

1. Exotic species added to list: a) to provide codes for database purposes (requested by Resources Inventory Branch); and b) to accommodate inventories being conducted near areas of settlement that may encounter escaped or naturalized exotics.

2. Hybrids that cannot be easily distinguished or are of doubtful existence were deleted from list. Operational option is to go to upper level generic code if suspected hybrids without codes are encountered; common hybrids still have codes. Deletions include: Sxe (*Picea engelmannii* x *sitchensis*), Sxb (*Picea glauca* x *mariana*), Sxx (*Picea glauca* x *engelmannii* x *sitchensis*), and Exw (*Betula occidentalis* x *papyrifera*).

3. Dm (*Alnus tenuifolia*) deleted as it is not known to exceed 10 m in height and is most often multi-stemmed.

Changes to Version 4.1 of B.C. Ministry of Forests Tree Code List

Sn (*Picea abies*) Norway Spruce was added. Note that some printed copies of version 4.0 had Norway spruce included but our master version required the update hence the minor version upgrade.

Changes to Version 4.2 of B.C. Ministry of Forests Tree Code List

Four exotic species requiring codes for database purposes were added: yellow birch (Ey), white ash (Oh), shagbark hickory (Oi), and white oak (Qw).

Changes to Version 4.3 of B.C. Ministry of Forests Tree Code List

One exotic species requiring a code for database purposes was added: Dahurian larch (Ld).

Appendix D: Damage Agent Codes

Source: "Pest Species Codes" Version 200001, Feb. 3, 2000
Data Custodian: Director, Forest Practices Branch, B.C. Ministry of Forests

This section lists the damage agents which affect B.C. trees, with codes used in the Change Monitoring Inventory. The damage agent codes which are highlighted by ■ should be recognized by "all" VRI sampling crews.

Damage Agent Codes				
Field Codes			**Description**	
O	No detectable abiotic or biotic damage			
U	Damage evident but causal agent unknown			
N	**NON-BIOLOGICAL (ABIOTIC) INJURIES**			
■	NB		Fire	
■	ND		Drought	
	NF		Flooding	
■	NG		Frost	
■		NGC	Frost crack	
		NGH	Frost heaved	
		NGK	Shoot / bud frost kill	
	NH		Hail	
	NK		Fumekill	
	NL		Lightning	
	NN		Road salt	
	NR		Redbelt	
	NS		Slide	
■	NW		Windthrow	
		NWS	Windthrow - soil failure	
		NWT	Windthrow - treatment or harvest related	
■	NX		Scarring and Rubbing	
	NY		Snow or ice (includes snow press)	
■	NZ		Sunscald	
D	**DISEASES**			
	DB		BROOM RUST	
		DBF	Fir broom rust	*Melampsorella caryophyllacearum*
		DBS	Spruce broom rust	*Chrysomyxa arctostaphyli*
■	DD		STEM ROT	
■		DDB	Birch trunk rot	*Fomes fomentarius*
■		DDD	Sulfur fungus	*Laetiporus sulphureus*

Damage Agent Codes				
Field Codes			**Description**	
■		DDE	Rust red stringy rot	*Echinodontium tinctorium*
■		DDF	Brown crumbly rot	*Fomitopsis pinicola*
■		DDH	Hardwood trunk rot	*Phellinus ignarius*
■		DDO	Cedar brown pocket rot	*Poria sericeomollis*
■		DDP	Red Ring Rot	*Phellinus pini*
■		DDQ	Quinine conk rot	*Fomitopsis officinalis*
■		DDS	Schweinitzii Butt Rot	*Phaeolus schweinitzii*
■		DDT	Aspen Trunk Rot	*Phellinus tremulae*
■	DF		FOLIAGE DISEASE	
		DFA	Western pine aster rust	*Coleosporium asterum*
		DFC	Large-spored spruce-labrador tea rust	*Chrysomyxa ledicola*
		DFD	Spruce needle cast	*Lirula macrospora*
		DFE	Elytroderma needle cast	*Elytroderma deformans*
		DFH	Larch needle cast	*Hypodermella laricis*
		DFL	Pine needle cast	*Lophodermella concolor*
		DFM	Larch needle blight	*Meria laricis*
		DFP	Fir-fireweed rust	*Pucciniastrum epilobi*
		DFR	Douglas-fir needle cast	*Rhabdocline pseudotsugae*
		DFS	Red band needle blight	*Mycosphaerella [Scirrhia] pini*
	DL		DISEASE CAUSED DIEBACK	
		DLD	Dermea canker	*Dermea pseudotsugae*
		DLF	Red flag disease	*Potebniamyces balsamicola*
		DLP	Phomopsis canker	*Phomopsis lokoyae*
		DLS	Sydowia (sclerophoma) tip dieback	*Sclerophoma pithyophila*
		DLV	Aspen-poplar twig blight	*Venturia* spp.
■	DM		DWARF MISTLETOE	
		DMF	Douglas-fir dwarf Mistletoe	*Arceuthobium douglasii*
		DMH	Hemlock Dwarf Mistletoe	*Arceuthobium tsugense*
		DML	Larch Dwarf Mistletoe	*Arceuthobium laricis*
		DMP	Lodgepole Pine Dwarf Mistletoe	*Arceuthobium americanum*
	DR		ROOT DISEASE	
■		DRA	Armillaria Root Disease	*Armillaria ostoyae*
■		DRB	Black Stain Root Disease	*Leptographium wageneri*
		DRC	Laminated Root Rot (cedar strain)	*Phellinus weirii*
■		DRL	Laminated Root Rot	*Inonotus sulphurascens*
■		DRN	Annosus Root Disease	*Heterobasidion annosum*
■		DRR	Rhizina Root Disease	*Rhizina undulata*

Damage Agent Codes

Field Codes			Description	
■		DRT	Tomentosus Root Rot	*Inonotus tomentosus*
	DS		STEM DISEASES (CANKERS & RUSTS)	
■		DSA	Atropellis Canker (Lodgepole Pine)	*Atropellis piniphila*
■		DSB	White Pine Blister Rust	*Cronartium ribicola*
■		DSC	Comandra Blister Rust	*Cronartium comandrae*
		DSE	Sooty bark canker	*Encoelia pruinosa*
■		DSG	Western Gall Rust	*Endocronartium harknessii*
		DSH	Hypoxylon canker	*Hypoxylon mammatum*
		DSP	Cryptosphaeria canker	*Cryptosphaeria populina*
		DSR	Ceratocystis canker	*Ceratocystis fimbriata*
■		DSS	Stalactiform Blister Rust	*Cronartium coleosporioides*
		DST	Target canker	*Nectria galligena*
		DSY	Cytospora canker	*Cytospora chrysosperma*
I	**INSECTS**			
	IA		APHIDS	
■		IAB	Balsam Woolly Adelgid	*Adelges piceae*
		IAC	Giant Conifer Aphid	*Cinara* spp.
		IAG	Cooley Spruce Gall Adelgid	*Adelges cooleyi*
		IAL	Western Larch Cone Woolly Aphid	*Adelges lariciatus*
		IAS	Green Spruce Aphid	*Elatobium abietinum*
■	IB		BARK BEETLES	
■		IBB	Western Balsam Bark Beetle	*Dryocetes confusus*
■		IBD	Douglas-fir Beetle	*Dendroctonus pseudotsugae*
		IBI	Engraver Beetles	*Ips* spp.
■		IBM	Mountain Pine Beetle	*Dendroctonus ponderosae*
		IBP	Twig beetles	*Pityogenes, Pityophthorus* spp.
■		IBS	Spruce Beetle	*Dendroctonus rufipennis*
		IBT	Red turpentine beetle	*Dendroctonus valens*
		IBW	Western pine beetle	*Dendroctonus brevicomis*
■	ID		DEFOLIATORS	
		IDA	Black Army Cutworm	*Actebia fennica*
		IDB	2-Year Budworm	*Choristoneura biennis*
		IDC	Larch Casebearer	*Coleophora laricella*
		IDD	Western winter moth	*Erannis tiliaria vancouverensis*
		IDE	Spruce Budworm	*Choristoneura fumiferana*
		IDF	Forest Tent Caterpillar	*Malacosoma disstria*
		IDG	Greenstriped Forest Looper	*Melanolophia imitata*
		IDH	Western Blackheaded Budworm	*Acleris gloverana*

Damage Agent Codes				
Field Codes			**Description**	
		IDI	Pine needle sheath miner	*Zellaria haimbachi*
		IDL	Western Hemlock Looper	*Lambdina fiscellaria lugubrosa*
		IDM	Gypsy Moth	*Lymantria dispar*
		IDN	Birch leaf miner	*Fenusa pusilla*
		IDP	Larch sawfly	*Pristophora erichsoni*
		IDR	Alder sawfly	*Eriocampa ovata*
		IDS	Conifer Sawflies	*Neodiprion* spp.
		IDT	Douglas-fir Tussock Moth	*Orgyia pseudotsugata*
		IDU	Satin moth	*Leucoma salicis*
		IDV	Variegated Cutworm	*Peridroma saucia*
		IDW	Western Spruce Budworm	*Choristoneura occidentalis*
		IDX	Large aspen tortrix	*Choristoneura conflictana*
		IDZ	Western False Hemlock Looper	*Nepytia freemani*
	IS		SHOOT INSECTS	
		ISB	Western cedar borer	*Trachykele blondeli*
		ISE	European Pine Shoot Moth	*Rhyaconia buoliana*
		ISG	Gouty pitch midge	*Cecidomyia piniinopis*
		ISP	Pitch Nodule Moths	*Petrova* spp.
		ISQ	Sequoia pitch moth	*Vespamima sequoiae*
		ISS	Western pine shoot borer	*Eucosma sonomana*
	IW		WEEVILS	
		IWC	Conifer Seedling Weevil	*Steremnius carinatus*
		IWM	Magdalis Species	*Magdalis* spp.
*		IWP	Lodgepole pine Terminal Weevil	*Pissodes terminalis*
*		IWS	White Pine weevil (on spruce)	*Pissodes strobi*
		IWW	Warren's Root Collar Weevil	*Hylobius warreni*
		IWY	Cylindrocopturus weevil	*Cylindrocopturus* spp.
		IWZ	Yosemite bark weevil	*Pissodes schwartzii*
M			**MITE DAMAGE**	*Trisetacus* spp.
T	**TREATMENT INJURIES**			
	TC		Chemical injury	
	TL		Logging wounds	
	TM		Other mechanical damage (non-logging)	
	TP		Planting (incorrectly planted)	
		TPM	Poor Planting Microsite	
	TR		Pruning wound	
	TT		Thinning or Spacing wound	

A	**ANIMAL DAMAGE**			
	AB		Bear	
	AC		Cattle	
	AD		Deer	
	AE		Elk	
	AH		Hare or rabbit	
	AM		Moose	
	AP		Porcupine	
	AS		Squirrel	
	AV		Vole	
	AX		Birds	
	AZ		Beaver	

Appendix E: Damage Severity and Mortality Condition Codes and Standards

This section lists the damage severity and mortality condition standards for individual trees in the Vegetation Inventory Samples (also used on growth and yield permanent sample plots) with codes and description.

Damage Severity and Mortality Condition Codes and Standards

Damage/condition or agent	Severity code	Code description and classification[2]
Mortality conditions for all agents	SR	Standing — Recent dead
	SO	Standing — Old dead
	WR	Windthrow — Root and butt rot
	WS	Windthrow — Soil failure
	WA	Windthrow- Management/soil related
	BD	Breakage — Stem decay (stubs and snags)
	BS	Breakage — Stem shear
Bark beetles	FA	Failed Attack
	GR	Current (Green) attack
	RA	Red Attack
	GY	Grey Attack
Defoliators, needle rusts and blights (general use) (Total crown rating scale: past and present attack)	Record % defoliated, discoloured, or infected.	Enter % (100% = – –)
Terminal weevils	Record: # years of attacks (1-9) and	1 to 9 attacks and
	M	Major crook
	N	Minor crook
	F	Forking
	S	Staghead
Stem rusts	BC	Branch Canker(s)

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[2] For detailed diagrams refer to *Minimum Standards for the Establishment and Remeasurement of Permanent Sample Plots in British Columbia*, Forest Productivity Councils of British Columbia, September 1995.

Damage Severity and Mortality Condition Codes and Standards		
Damage/condition or agent	**Severity code**	**Code description and classification[2]**
	SC	Stem Canker(s)
	TK	Top-Kill
Root Rots	W5	Within 5 m of *A. Ostoyae* infection source
	LC	Light Crown symptoms
	SC	Severe Crown symptoms
	RL	Basal resinosis (Light) ≤ 50% circumference
	RS	Basal resinosis (Severe) > 50% circumference
	BR	Butt Rot
	CS	Confirmatory Symptoms; stain, decay, mycelia, rhizomorphs, or sporophores
Dwarf Mistletoes (Hawksworth's 6-class rating system) for all species	Enter one 1, 2, 3, 4, 5, 6	
For coastal western hemlock Stem swelling defect classes	N M	≥ minor stem swelling per tree ≥ major stem swelling per tree
Mammals, birds, and root collar weevil (girdlers)	Record % girdled	enter % 100% = (– —)
Defoliators Western Spruce Budworm (current foliage only)	Record % defoliated	enter % 100% = (– —) 1–20% current year's foliage, bud, and/or shoot destruction
Defoliators Douglas-fir Tussock moth	Record % defoliated	enter % 100% = (– –)

Appendix F: Calculating Plot Slope Allowances

SLOPE ALLOWANCES

		Plot Size					Plot Size		
% Slope	**Factor**	**5.64**	**10.00**	**11.28**	**% Slope**	**Factor**	**5.64**	**10.00**	**11.28**
2	1.000	5.64	10.00	11.28	62	0.850	6.64	11.77	13.27
4	0.999	5.64	10.01	11.29	64	0.842	6.70	11.87	13.39
6	0.998	5.65	10.02	11.30	66	0.835	6.76	11.98	13.52
8	0.997	5.66	10.03	11.32	68	0.827	6.82	12.09	13.64
10	0.995	5.67	10.05	11.34	70	0.819	6.88	12.21	13.77
12	0.993	5.68	10.07	11.36	72	0.812	6.95	12.32	13.90
14	0.990	5.70	10.10	11.39	74	0.804	7.02	12.44	14.03
16	0.987	5.71	10.13	11.42	76	0.796	7.08	12.56	14.17
18	0.984	5.73	10.16	11.46	78	0.789	7.15	12.68	14.31
20	0.981	5.75	10.20	11.50	80	0.781	7.22	12.81	14.45
22	0.977	5.77	10.24	11.55	82	0.773	7.29	12.93	14.59
24	0.972	5.80	10.28	11.60	84	0.766	7.37	13.06	14.73
26	0.968	5.83	10.33	11.66	86	0.758	7.44	13.19	14.88
28	0.963	5.86	10.38	11.71	88	0.751	7.51	13.32	15.03
30	0.958	5.89	10.44	11.78	90	0.743	7.59	13.45	15.18
32	0.952	5.92	10.50	11.84	92	0.736	7.66	13.59	15.33
34	0.947	5.96	10.56	11.91	94	0.729	7.74	13.72	15.48
36	0.941	5.99	10.63	11.99	96	0.721	7.82	13.86	15.64
38	0.935	6.03	10.70	12.07	98	0.714	7.90	14.00	15.79
40	0.928	6.07	10.77	12.15	100	0.707	7.98	14.14	15.95
42	0.922	6.12	10.85	12.23	102	0.700	8.06	14.28	16.11
44	0.915	6.16	10.93	12.32	104	0.693	8.14	14.43	16.27
46	0.908	6.21	11.01	12.42	106	0.686	8.22	14.57	16.44
48	0.902	6.26	11.09	12.51	108	0.679	8.30	14.72	16.60
50	0.894	6.31	11.18	12.61	110	0.673	8.38	14.87	16.77
52	0.887	6.36	11.27	12.71	112	0.666	8.47	15.01	16.94
54	0.880	6.41	11.36	12.82	114	0.659	8.55	15.16	17.11
56	0.873	6.46	11.46	12.93	116	0.653	8.64	15.32	17.28
58	0.865	6.52	11.56	13.04	118	0.647	8.72	15.47	17.45
60	0.857	6.58	11.66	13.15	120	0.640	8.81	15.62	17.62

Appendix G: B.C. Land Cover Classification

Introduction

The Vegetation Inventory Working Group, a component of the Resources Inventory Committee (RIC), was given the task of creating a land cover classification system to meet the needs of British Columbia's resource managers today and in the future. Present inventory systems were found to be inadequate when used to assess integrated resource management options. It was from this perspective, along with growing world-wide demand for an accurate assessment of land cover, that the classification scheme was created.

The B.C. Land Cover Classification Scheme was designed to meet present provincial and national needs, and to be capable of providing data for global vegetation accounting as proposed by Bones (1993) for the Forest Resources Division of the Food and Agriculture Organization of the United Nations (FAO). In designing the B.C. system, the working group examined a number of classification systems, including Dansereau 1957, Küchler 1967, Fosberg 1967, Ellenberg and Mueller-Dombois 1967 (UNESCO), Ellenberg 1973, National Vegetation Working Group 1990, Viereck et al. 1992, Alberta Forestry, Lands and Wildlife 1992, and Bones 1993. The intent was to make a useful functional system for B.C. while retaining compatibility with other systems. The new classification will take the place of the old timber-based inventory system.

The B.C. Land Cover Classification Scheme meets all 12 criteria suggested by Bones (1993) for international standard forest definitions and classifications see Appendix A for a list of the 12 criteria). The B.C. system embraces the first criteria that the classification be based on current cover (vegetated or non-vegetated), not on climax or potential cover. As well, the revised system has no culturally biased terms such as the old term "non-productive brush." This provides an unbiased assessment of what exists at the time of the inventory, not what potentially could exist. Beyond the classification levels, additional attributes can be specified to provide more information on a described unit. For example, the plant association found on the site or the silvicultural treatments done on that unit can be described.

This manual describes the various steps and levels in the classification system. A schematic of the classification is shown in Figures 1 and 2 to help visualize the entire system. Appendix B provides definitions of all classes used. Appendix E provides a comparison of the B.C. Scheme with other systems.

Who will use the information?

The B.C. classification system will be used as a baseline for resource managers when making integrated resource management decisions. For example, information will be available to wildlife managers on the extent of various vegetation communities, such as the location of areas covered by browse species. Hydrologists will have access to information on vegetation cover relating to hydrological green-up on a drainage-by-drainage basis. Range managers will be able to assess the extent of grass- and herb-dominated sites when determining range options. Timber managers will be provided with an assessment of the timber resource, including all of the present information and additional details on adjacent land cover. The classification will also provide snapshots of land cover that can be used as benchmarks for tracking global and local changes.

Classifying Land Cover

The B.C. Land Cover Classification Scheme is based on current cover. Cover can be vegetated, non-vegetated or unreported. Vegetated cover is either treed or non-treed; non-vegetated cover is either land or water. In most cases, uniform areas (polygons) are delineated on mid-scale aerial photographs (1:10 000 to 1:20 000). Each polygon is then assessed using hierarchical classes, first into Vegetated, Non-Vegetated, or Unreported, then by cover type, landscape position, and so on, to the lowest level identifiable.

Below is a decision chart for the classification scheme. Figures 1 and 2 illustrate the classification scheme structure for vegetated and non-vegetated areas, respectively. Unreported areas may be vegetated or non-vegetated, but their attributes are either unknown (as in the case of parks) or they are outside the area being reported (as in the case of Tree Farm Licenses or Tree Farms).

The B.C. Land Cover Classification Scheme Decision Chart

- Level 1 - Vegetated or not
- Level 1 - Vegetated (has 4 further levels)
  - Level 2 - Land cover type - Treed or Non-Treed
    - Level 3 - Landscape position - Wetland, Upland, or Alpine
      - Level 4 - Vegetation type (varies with Treed or Non-Treed unit)
        - Level 5 - Density class
- Level 1 - Non-Vegetated (has 4 further levels)
  - Level 2 - Land or Water
  - Level 2 - Land
    - Level 3 - Landscape position - Wetland, Upland, or Alpine
      - Level 4 - Cover type
        - Level 5 - Cover categories
  - Level 2 - Water
    - Level 3 - Landscape position - Wetland, Upland, or Alpine
      - Level 4 - none for Water
        - Level 5 - Water categories

Polygon Attribute - The Information Source for the Cover Designation

Application of the B.C. Land Cover Classification Scheme provides a land cover designation based on the categories described below. The cover for each polygon is derived from polygon attributes estimated by photo interpretation and calibrated by air and ground surveys.

Attribute estimation from air photos is described in the Vegetation Resources Inventory Photo Interpretation Procedures.

The land cover designation provides a categorization of the polygon based on the BC Land Cover Classification Scheme. Lower layer (such as shrubs, herbs, and bryoids) vegetation information is not provided as part of the map label when a higher layer (such as trees) exists. Data are available for the other layers within the polygon attribute file. Resource managers can access various levels of detail, depending on their objectives.

The Coding System

The land classification of each polygon is summarized as a seven-letter code to facilitate broad land classification reporting. The classification scheme also provides the criteria for distinguishing cover types within the polygon. These criteria are critical for assessing specific tree, shrub, herbaceous, bryoid, and non-vegetated communities within polygon boundaries (referred to as land cover components). Code letters are given in the detailed descriptions that follow.

The following is an example of the derivation of the seven-letter Land Cover Class Code:

Level	**Estimated attributes**	**Code assigned**
1	Vegetated crown closure ≥5%	V (Vegetated)
2	Tree crown closure ≥10%	T (Treed)
3	Not Wetland	U (Upland)
4	Coniferous ≥75% of total Crown Closure	TC (Treed-Coniferous)
5	Tree crown closure = 80%	DE (Dense)

The Land Cover Class Code for this polygon would be VTUTCDE.

Vegetated Polygons

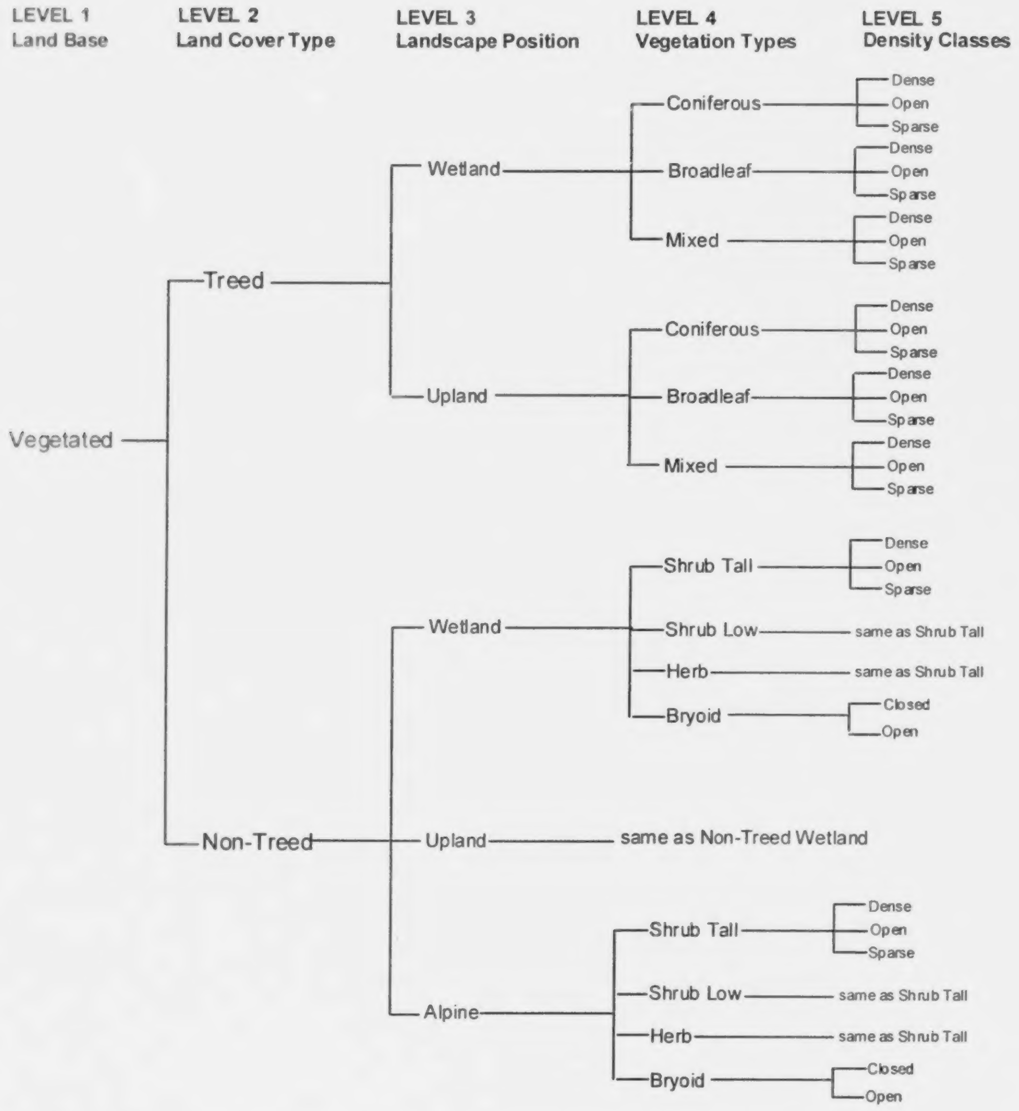

Figure G.1 - Structure of the B.C. Land Cover Classification Scheme - Vegetated polygons

Non-Vegetated Polygons

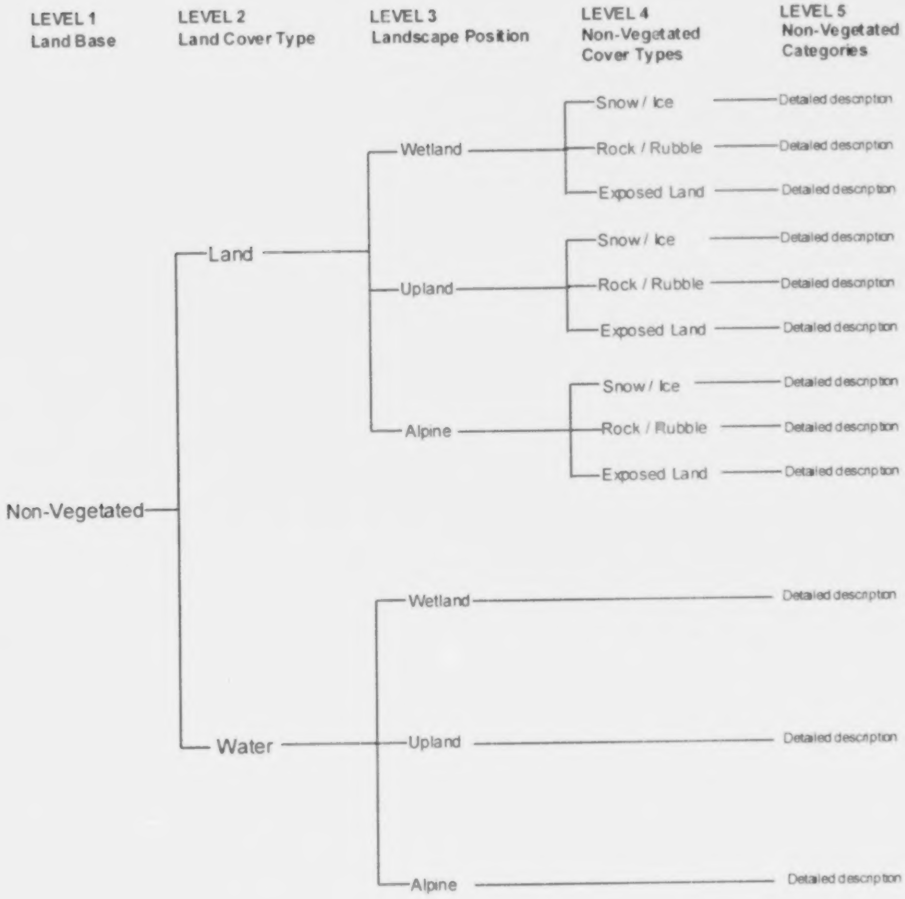

Figure G.2 - Structure of the B.C. Land Cover Classification Scheme - Non-Vegetated polygons

Level 1 - Classifying the Land Base

The first level of the classification scheme classifies the presence or absence of vegetation, as Vegetated, Non-Vegetated, or Unreported.

V = **Vegetated**
A polygon is considered Vegetated when the total cover of trees, shrubs, herbs, and bryoids (other than crustose lichens) covers at least 5% of the total surface area of the polygon.

N = **Non-Vegetated**
A polygon is considered Non-Vegetated when the total cover of trees, shrubs, herbs, and bryoids covers less than 5% of the total surface area of the polygon. Bodies of water are to be classified as Non-Vegetated.

U = **Unreported**
A polygon is classified as Unreported if it is within the mapsheet being reported on, but is outside the inventory unit of interest. The Unreported designation is restricted to areas where inventory information is not currently available. Examples include National Parks, Provincial Parks (where information is not available), Tree Farm Licences and Tree Farms that are not in the existing vegetation cover databases, and areas outside of the Province of British Columbia.

Classifying Vegetated Polygons

If the polygon is classed as Vegetated the following levels apply.
(If classified as Non-Vegetated see *Classifying Non-Vegetated Polygons* for a description of further levels.)

Level 2 - Land Cover Type

The first determination for Vegetated polygons is whether they are Treed or Non-Treed.

T = **Treed**
A polygon is considered Treed if at least 10% of the polygon area, by crown cover, consists of tree species of any size. See Appendix C for a list of tree species for B.C.

N = **Non-Treed**
A polygon is considered Non-Treed if less than 10%, by crown cover, of the polygon area consists of tree species of any size.

Note: Tree species less than 10 m high are not classed as shrubs (as they are in ecological surveys).

Level 3 - Landscape Position

Once the polygon has been classified into Treed or Non-Treed, the location relative to elevation and drainage is determined.

W = **Wetland**
Wetland has numerous definitions in the literature. The definition used for the classification is taken from Fraser et al. (1995):

Wetland is defined as land having the water table at, near or above the soil surface that remains saturated for a long enough period of time to promote wetland or aquatic processes. These processes are indicated by the presence of Organic or Gleysolic soils and hydrophytic vegetation. See Appendix B for a more complete definition of Wetland.

U = **Upland**
A broad class that includes all non-wetland ecosystems below Alpine that range from very xeric to hygric soil moisture regimes.

A = **Alpine**
Treeless (for practical purposes less than 1% tree cover can be included within the Alpine category), with vegetation dominated by shrubs, herbs, graminoids, bryoids, and lichens. Much of the Alpine is dominated by rock, ice, and snow. Alpine does not typically include the parkland and krummholz forest types. Alpine is a classification level of Non-Treed areas above the tree line only.

Level 4 - Vegetation Type

Once the polygon is classed as Treed or Non-Treed and determined whether it is Wetland, Upland, or Alpine, it is further classified by the type of vegetation within the unit:

Vegetated Treed

Treed units can be either Coniferous, Broadleaf, or Mixed.

TC = **Treed – Coniferous**
Defined as those trees found in B.C. within the order Coniferae. These species are commonly referred to as conifer or softwoods. See Appendix C for a list of B.C. species and species codes.

The polygon is classified as Coniferous when trees cover a minimum of 10% of the total polygon area by crown cover, and coniferous trees are 75% or more of the total tree basal area.

TB = **Treed - Broadleaf**
Defined as those trees classified botanically as Angiospermae in the subclass Dicotyledoneae. These species are commonly referred to as deciduous or hardwoods. See Appendix C for a list of B.C. species and species codes.

The polygon is classified as Broadleaf when trees cover a minimum of 10% of the total polygon area by crown cover, and broadleaf trees are 75% or more of the total tree basal area.

TM = **Treed – Mixed**
The polygon is classified as Mixed when trees cover a minimum of 10% of the total polygon area by crown cover, but neither coniferous nor broadleaf trees account for 75% or more of the total tree basal area.

Vegetated Non-Treed Units

Non-Treed units can be either Shrub, Herb, or Bryoid.

Non-Treed Shrub

Shrubs are defined as multi-stemmed woody perennial plants, both evergreen and deciduous. A reporting break is made between Tall (greater than or equal to 2 m) and Low (less than 2 m) for wildlife management interpretation purposes. Other breaks may be used if preferred, as height data are estimated as a continuous variable.

For a polygon to be classed as Non-Treed Shrub, it must have more than 5% total vegetation cover, have less than 10% of crown cover of trees, and have a minimum of 20% ground cover of shrubs, or shrubs must constitute more than 1/3 of the total vegetation cover.

ST = **Shrub Tall**
A Shrub polygon with average height greater than or equal to 2 m.

SL = **Shrub Low**
A Shrub polygon with average shrub height less than 2 m.

Non-Treed Herb

Herbs are defined, for this system, as vascular plants without a woody stem, including ferns, fern allies, some dwarf woody plants, grasses, and grass-like plants. See Appendix D for a list of low woody species and species of doubtful life form assigned for this classification to the herb layer.

The Herb class has two further subdivisions based on the proportion of forbs and graminoid plants. The subclasses Forbs and Graminoids are used when any one group accounts for greater than 50% of the herb cover.

Graminoids are defined as herbaceous plants with long, narrow leaves characterized by linear venation; including grasses, sedges, rushes, and other related species.

Forbs are defined as herbaceous plants other than graminoids, including ferns, clubmosses, and horsetails.

For a polygon to be classed as Non-Treed Herb it must have more than 5% total vegetation cover, have less than 10% crown cover of trees, and have a minimum of 20% ground cover of herbs, or herbs must constitute more than 1/3 of the total vegetation cover, and have less than 20% shrub cover.

HE = **Herb**
A Herb polygon with no distinction between forbs and graminoids.

HF = **Herb – Forbs**
A Herb polygon with forbs greater than 50% of the herb cover.

HG = **Herb – Graminoids**
A Herb polygon with graminoids greater than 50% of the herb cover.

Non-Treed Bryoid

Bryoids are defined as bryophytes (mosses, liverworts, and hornworts) and lichens (foliose or fruticose; not crustose).

For a polygon to be classed Non-Treed Bryoid it must have more than 5% total vegetation cover, have less than 10% crown cover of trees, and have greater than 50% of the vegetation cover in bryoids, and herb and shrub cover must each be less than 20% crown cover.

The Bryoid class has two further subdivisions based on the proportion of bryophytes and lichens. The class is subdivided into Bryophyte or Lichen when any one group accounts for greater than 50% of the bryoid cover.

BY = **Bryoids**
A Bryoid polygon with no distinction between mosses and lichens by cover.

BM = **Bryoid – Moss**
A Bryoid polygon with mosses, liverworts, and hornworts greater than 50% of the bryoid cover.

BL = **Bryoid – Lichens**
A Bryoid polygon with lichens (foliose or fruticose; not crustose) greater than 50% of the bryoid cover.

Level 5 - Density Class

Once a Vegetated polygon is classed up to Level 4, density is reported using the following density classes available by vegetation type. Note that these are reporting breaks only; interpreters will estimate density in a continuous manner (from 0% to 100%).

The density classes for Treed, Shrub, or Herb polygons are as follows:

DE = **Dense**
Tree, shrub, or herb cover is between 61% and 100% crown closure for the polygon.

OP = **Open**
Tree, shrub, or herb cover is between 26% and 60% crown closure for the polygon.

SP = **Sparse**
Tree cover is between 10% and 25% for Treed polygons, or between 20% and 25% for Shrub or Herb polygons.

The density classes for Bryoid polygons are as follows:

CL = **Closed**
Cover of bryoids is greater than 50% of the polygon.

OP = **Open**
Cover of bryoids is less than or equal to 50% of the polygon.

Classifying Non-Vegetated Polygons

A polygon is considered Non-Vegetated when the total cover of trees, shrubs, herbs, and bryoids covers less than 5% of the total surface area of the polygon.

Level 2 - Land Cover Type

The first decision is whether a polygon is considered to be Land or a Water body. The cover type occupying greater than 50% of the polygon area is the cover type assigned.

L = **Land**
The portion of the landscape not covered by water (as defined below), based on the percentage cover area.

W = **Water**
A naturally occurring, static body of water, two or more metres deep in some portion, or a watercourse formed when water flows between continuous, definable banks. These flows may be intermittent or perennial; but do not include ephemeral flows where a channel with no definable banks is present. Islands within streams that have definable banks are not part of the stream; gravel bars are part of the stream. Interpretation is based on the percentage area covered.

Classifying Non-Vegetated Land Polygons

If the polygon is classed as Land the following steps and levels apply.
(If classed as Water see Land Cover Type - Water for a description of further levels.)

Level 3 - Landscape Position (Land)

This level describes the location of the polygon relative to elevation and drainage, and is described as Wetland, Upland, or Alpine. In rare cases, the polygon may be Alpine Wetland.

W = **Wetland**
Land having a water table near, at, or above the soil surface, or which is saturated for a long enough period to promote wetland or aquatic processes. These processes are indicated by the presence of Organic or Gleysolic soils and hydrophytic vegetation. See Appendix B for a more complete definition of Wetland.

U = **Upland**
A broad class that includes all non-wetland ecosystems below alpine that range from very xeric to hygric soil moisture regimes.

A = **Alpine**
Treeless (for practical purposes less than 1% tree cover can be included within the Alpine category), with vegetation dominated by shrubs, herbs, graminoids, bryoids, and lichens. Much of the Alpine is dominated by rock, ice, and snow. Alpine does not typically include the parkland and krummholz forest types. Alpine is a classification of Non-Treed areas above the tree line only.

Level 4 - Non-Vegetated Cover Type (Land)

Once the polygon is classed as Non-Vegetated and determined whether it is Wetland, Upland, or Alpine, it is further classified by the type of non-vegetated condition within the unit. Non-Vegetated polygons are divided into three groups: Snow/Ice, Rock/Rubble, and Exposed Land.

SI = **Snow/Ice**
Defined as either glacier or snow cover.

RO = **Rock/Rubble**
Defined as bedrock or fragmented rock broken away from bedrock surfaces and moved into its present position by gravity or ice. Extensive deposits are found in and adjacent to alpine areas and are associated with steep rock walls and exposed ridges; canyons and cliff areas also contain these deposits.

EL = **Exposed Land**
Contains all other forms of Exposed Land identified by a range of subclasses.

Level 5 - Non-Vegetated Categories (Land)

Classes are defined by the dominant material or feature of the non-vegetated area.

Snow/Ice has two subclasses - **Glacier** and **Snow Cover**:

GL = **Glacier**
A mass of perennial snow and ice with definite lateral limits, typically flowing in a particular direction.

PN = **Snow Cover**
Snow or ice that is not part of a glacier, but is found during summer months on the landscape.

Rock/Rubble has four subclasses:

BR = **Bedrock**
Unfragmented, consolidated rock contiguous with the underlying material.

TA = **Talus**
Rock fragments of any size accumulated on or at the foot of slopes as a result of successive rock falls. This is a type of colluvium.

BI = **Blockfield**
Blocks of rock derived from the underlying bedrock by weathering and / or frost

heaving. These have not undergone any significant down slope movement as they occur on level or gently sloping areas.

MZ = **Rubbly Mine Spoils**
Discarded overburden or waste rock moved to extract ore during a mining operation.

LB = **Lava Bed**
An area where molten rock has flowed from a volcano or fissure and cooled and solidified to form rock.

Exposed Land has 16 subclasses:

RS = **River Sediments**
Silt, gravel, and sand bars associated with former river channels and present river edges.

ES = **Exposed Soil**
Any exposed soil not covered by the other categories, such as areas of recent disturbance including mud slides, debris torrents, avalanches, or disturbances such as pipeline rights-of-way or cultivated fields, where vegetation cover is less than 5%.

LS = **Pond or Lake Sediments**
Exposed sediments related to dried-up lakes or ponds.

RM = **Reservoir Margin**
Land exposed by a drained or fluctuating reservoir. It is found above "normal" water levels and may consist of a range of substrates including gravel, cobbles, fine sediments, or bedrock.

BE = **Beach**
An area with sorted sediments reworked in recent time by wave action. It may be formed at the edge of fresh or salt water bodies.

LL = **Landing**
A compacted area adjacent to a road used for sorting and loading logs.

BU = **Burned Area**
Land showing evidence of recent burning, either natural or prescribed. Vegetation of less than 5% crown cover is present at the time of polygon description.

RP = **Road Surface**
An area cleared and compacted for transporting goods and services by vehicles. Older roads that are used infrequently or not at all may cease to be classified as non-vegetated.

MU = **Mudflat Sediment**
Flat plain-like areas associated with lakes, ponds, rivers, or streams — dominated by fine-textured sediments, they can be associated with freshwater or estuarine sources.

CB = **Cutbank**
Part of a road corridor created upslope of the road surface by excavation into the hillside.

MN = **Moraine**
An area of debris transported and deposited by a glacier.

GP = **Gravel Pit**
An area exposed through the removal of sand and gravel.

TZ = **Tailings**
An area containing the solid waste material produced by the mining and milling of ore.

RN = **Railway Surface**
A roadbed with fixed rails, may contain single or multiple rail lines.

UR = **Urban**
Buildings and associated developments such as roads and parking areas which form an almost continuous covering of the landscape.

AP = **Airport**
A permanent, paved or gravel area, and associated buildings and parking, used by airplanes.

MI = **Open Pit Mine**
An exposed area used to extract ore during a mining operation. This may contain associated buildings and any tailing produced by the mining and milling process.

OT = **Other**
A Non-Vegetated polygon where none of the above categories can be reliably chosen.

Classifying Non-Vegetated Water Polygons

If the polygon is classed as Water the following categories apply:

Level 3 - Landscape Position (Water)

The landscape position relative to elevation and drainage is determined.

W = **Wetland**
Land having a water table near, at, or above the soil surface, which is saturated for a long enough period to promote wetland or aquatic processes. These wetland processes are indicated by the presence of Organic or Gleysolic soils and hydrophytic vegetation. See Appendix B for a more complete definition of Wetland.

U = **Upland**
A broad class that includes all non-wetland ecosystems below alpine that range from very xeric to hygric soil moisture regimes.

A = **Alpine**
Treeless (for practical purposes less than 1% tree cover can be included within the Alpine category), with vegetation dominated by shrubs, herbs, graminoids, bryoids, and lichens. Much of the Alpine is dominated by rock, ice, and snow. Alpine does not typically include the parkland and krummholz forest types. Alpine is a classification of Non-Treed areas above the tree line only.

Level 4 - No Level 4 for Water

There are no classes at this level (Land Cover Type) for Water.

Level 5 - Water Categories

Four categories have been identified: Lake, Reservoir, River/Stream, and Salt Water.

LA = **Lake**
A naturally occurring static body of water more than two metres deep in some portion. The boundary for the lake is the natural high water mark.

RE = **Reservoir**
An artificial basin affected by impoundment behind a human fabricated structure such as a dam, berm, dyke, or wall.

RI = **River/Stream**
A watercourse formed when water flows between continuous, definable banks. Flow may be intermittent or perennial, but does not include ephemeral flow where a channel with no definable banks is present. Gravel bars are part of a stream, while islands within a stream that have definable banks are not.

OC = **Ocean**
A naturally occurring body of water containing salt or generally considered to be salty.

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Appendix H: Latitude and Longitude for Selected Points in B.C. and Declination Values

This appendix provides latitude and longitude for selected points in British Columbia and declination values. Values for a specific location (using latitude and longitude) may be calculated by accessing the website at http://www.geolab.nrcan.gc.ca/geomag/mirp_e.shtml

Magnetic Declination for April 1, 2005

Region	Location	Latitude	Longitude	Declination	Declination
		(in degrees, minutes)		Deg, Min	Decimal Deg.
Coastal	Chilliwack	49° 10'	121° 57'	18° 33' E	18.6° E
Coastal	Haney	49° 13'	122° 36'	18° 43' E	18.7° E
Coastal	Abbotsford	49° 03'	122° 17'	18° 35' E	18.6° E
Coastal	Vancouver	49° 15'	123° 07'	18° 50' E	18.8° E
Coastal	Squamish	49° 45'	123° 07'	19° 1' E	19° E
Coastal	Powell River	49° 51'	124° 32'	19° 20' E	19.3° E
Coastal	Campbell River	50° 01'	125° 20'	19° 33' E	19.6° E
Coastal	Port McNeill	50° 35'	127° 06'	20° 2' E	20° E
Coastal	Gold River	49° 41'	126° 07'	19° 33' E	19.6° E
Coastal	Nanaimo	49° 10'	123° 56'	18° 59' E	19° E
Coastal	Tofino	49° 07'	125° 53'	19° 19' E	19.3° E
Coastal	Duncan	48° 47'	123° 42'	18° 48' E	18.8° E
Coastal	Port Alberni	49° 14'	124° 48'	19° 10' E	19.2° E
Coastal	Sayward	50° 23'	125° 58'	19° 47' E	19.8° E
Coastal	Holberg	50° 39'	128° 01'	20° 10' E	20.2° E
Coastal	Port Renfrew	48° 33'	124° 25'	18° 52' E	18.9° E
Coastal	Massett	54° 01'	132° 06'	21° 45' E	21.8° E
Coastal	Queen Charlotte City	53° 15'	132° 07'	21° 25' E	21.4° E
Coastal	Klemtu	52° 35'	128° 31'	20° 59' E	21° E
Coastal	Hagensborg	52° 23'	126° 33'	20° 40' E	20.7° E
Coastal	Security Bay	51° 22'	127° 28'	20° 23' E	20.4° E
Coastal	Alison Sound	51° 15'	127° 00'	20° 16' E	20.3° E
Coastal	Pemberton	50° 19'	122° 48'	19° 10' E	19.2° E
Coastal	Boston Bar	49° 52'	121° 26'	18° 42' E	18.7° E

Region	Location	Latitude	Longitude	Declination	Declination
		(in degrees, minutes)		Deg, Min	Decimal Deg.
Coastal	Stuart Island	50° 22'	125° 08'	19° 38' E	19.6° E
Coastal	Sewell Inlet	52° 53'	131° 59'	21° 15' E	21.3° E
Coastal	Franklin River	49° 00'	124° 45'	19° 5' E	19.1° E
Coastal	Rivers Inlet	51° 41'	127° 15'	20° 28' E	20.5° E
Coastal	Prince Rupert	54° 18'	130° 20'	21° 51' E	21.9° E
Northern	Burns Lake	54° 14'	125° 46'	21° 23' E	21.4° E
Northern	Houston	54° 27'	126° 37'	21° 37' E	21.6° E
Northern	Smithers	54° 47'	127° 11'	21° 51' E	21.9° E
Northern	Hazelton	55° 14'	127° 35'	22° 7' E	22.1° E
Northern	Terrace	54° 31'	128° 36'	21° 51' E	21.9° E
Northern	Stewart	55° 57'	130° 00'	22° 39' E	22.7° E
Northern	Lower Post	59° 55	128° 30'	24° 52' E	24.9° E
Northern	Bob Quinn Lake	56° 58'	130° 15'	23° 9' E	23.2° E
Northern	Dease Lake	58° 26'	130° 00'	23° 59' E	24° E
Northern	Atlin	59° 35'	133° 41'	24° 18' E	24.3° E
Northern	Valemount	52° 50'	119° 15'	19° 25' E	19.4° E
Northern	McBride	53° 18'	120° 10'	19° 51' E	19.9° E
Northern	Hixon	53° 25'	122° 35'	20° 26' E	20.4° E
Northern	Prince George	53° 55'	122° 45'	20° 42' E	20.7° E
Northern	Bear Lake (HartHwy)	54° 30'	122° 41'	20° 59' E	21° E
Northern	Vanderhoof	54° 01'	124° 01'	20° 59' E	21° E
Northern	Kenny Dam	53° 35'	124° 57'	20° 57' E	21° E
Northern	Ft. St. James	54° 26'	124° 15'	21° 14' E	21.2° E
Northern	Takla Landing	55° 29'	125° 58'	22° 4' E	22.1° E
Northern	Manson Creek	55° 40'	124° 29'	21° 56' E	21.9° E
Northern	Aiken Lake	56° 26'	125° 45'	22° 35' E	22.6° E
Northern	Bear Lake (Driftwood)	56° 12'	126° 51'	22° 35' E	22.6° E
Northern	Mackenzie	55° 18'	123° 10'	21° 29' E	21.5° E
Northern	Fort Ware	57° 26'	125° 38'	23° 11' E	23.2° E
Northern	Ingenika Point	56° 47'	124° 54'	22° 40' E	22.7° E
Northern	Ingenika Mine	56° 42'	125° 11'	22° 40' E	22.7° E
Northern	Dawson Creek	55° 46'	120° 14'	21° 1' E	21° E
Northern	Chetwynd	55° 42'	121° 38'	21° 22' E	21.4° E
Northern	Tumbler Ridge	55° 07'	121° 00'	20° 54' E	20.9° E
Northern	Fort St. John	56° 15'	120° 51'	21° 27' E	21.5° E
Northern	Beaton River (settl.)	57° 23'	121° 25'	22° 17' E	22.3° E

Region	Location	Latitude	Longitude	Declination	Declination
		(in degrees, minutes)		Deg. Min	Decimal Deg.
Northern	Pink Mountain	57° 02'	122° 31'	22° 21' E	22.4° E
Northern	Fort Nelson	58° 48'	122° 43'	23° 34' E	23.6° E
Northern	Muncho Lake	58° 56'	125° 46'	24° 11' E	24.2° E
Northern	Nelson Forks	59° 30'	124° 01'	24° 19' E	24.3° E
Southern	Chase	50° 49'	119° 41'	18° 40' E	18.7° E
Southern	Lillooet	50° 40'	121° 56'	19° 7' E	19.1° E
Southern	Merritt	50° 07'	120° 47'	18° 52' E	18.9° E
Southern	Princeton	49° 28'	120° 30'	18° 20' E	18.3° E
Southern	Penticton	49° 30'	119° 35'	18° 8' E	18.1° E
Southern	Vernon	50° 16'	119° 16'	18° 21' E	18.4° E
Southern	Salmon Arm	50° 42'	119° 16'	18° 31' E	18.5° E
Southern	Kamloops	50° 40'	120° 19'	18° 46' E	18.8° E
Southern	Clearwater	51° 39'	120° 02'	19° 6' E	19.1° E
Southern	Beaverdell	49° 26'	119° 05'	17° 59' E	18° E
Southern	Castiegar	49° 19'	117° 39'	17° 33' E	17.6° E
Southern	Cranbrook	49° 30'	115° 46'	17° 1' E	17° E
Southern	Creston	49° 06'	116° 31'	17° 8' E	17.1° E
Southern	Flathead	49° 22'	114° 37'	16° 32' E	16.5° E
Southern	Golden	51° 18'	116° 58'	18° 6' E	18.1° E
Southern	Grand Forks	49° 02'	118° 27'	17° 40' E	17.7° E
Southern	Invermere	50° 31'	116° 02'	17° 28' E	17.5° E
Southern	Kalso	49° 55'	116° 54'	17° 33' E	17.6° E
Southern	Mica Creek	52° 00'	118° 34'	18° 52' E	18.9° E
Southern	Nakusp	50° 14'	117° 48'	17° 56' E	17.9° E
Southern	Nelson	49° 29'	117° 17'	17° 30' E	17.5° E
Southern	Revelstoke	50° 59'	118° 12'	18° 21' E	18.4° E
Southern	Sparwood	49° 43'	114° 53'	16° 45' E	16.8° E
Southern	Quesnel townsite	52° 59'	122° 30'	20° 13' E	20.2° E
Southern	Farwell Canyon	51° 49'	122° 34'	19° 43' E	19.7° E
Southern	mid - Horsefly Lake	52° 24'	121° 02'	19° 39' E	19.7° E
Southern	100 Mile House Townsite	51° 39'	121° 17'	19° 23' E	19.4° E
Southern	Chilanko Forks Settlement	52° 07'	124° 04'	20° 8' E	20.1° E

Appendix I: Modifications to Ground Sample Marking Procedures as required by Land Custodian

Introduction:

The NFI ground sampling procedures include extensive requirements for sample layout. These procedures may need to be modified in instances where samples or the access route fall within special management areas such as parks and recreation sites, private lands, or areas that are in high use by the public. The custodian of the lands in question (be they the Ministry of Water Land and Air Protection, Federal government departments, private landowners, etc) should always be contacted to determine their specific requirements and to obtain permission to locate the sample. Consultation with the custodian will also help determine which of the modifications below need to be used. All samples located on private land or special areas of interest must:

a. have a signed agreement with the land owner on file

b. have a description of the agreed upon plot marking procedures signed and on file

The following document is intended to be used by project managers, when planning sampling projects, as a guide on how to modify the sample marking procedures on such samples and how to go about relocating them for audits or other uses. In general, the modifications should not significantly affect the time it takes to establish a sample.

Modifications to marking procedures:

These modifications are intended to make the sample as "invisible" to a casual observer at the sample as possible. Some items such as soil pits are going to be somewhat visible regardless of procedure modifications.

1. Do not ribbon, spray paint, blaze or limb any tree on the sample, including the tie point or reference tree. Crews may wish to temporarily hang a ribbon on trees in the sample cluster to aid in measurement and reduce confusion, but they must be removed prior to leaving the sample.

2. The route from Tie Point Tree to Reference Point location should not to be ribboned, and there must not be any ribbon at the IPC. Crews may place ribbon for use while at the plot (for example, to aid in estimating cover for ecological plots), but all ribbon must be removed prior to leaving the site.

3. CWD intersections are not to be painted or otherwise marked, but a stick or branch should be pushed into the ground at the end of each transect.

4. Additional effort to collect GPS positions in the field should be expended for the IPC and the Tie point.

5. If permitted, stem map nails should be placed.

6. Crews need to take a minimum of one picture (in addition to the regular NFI requirements) at the reference pin facing towards the IPC to aid in relocating the IPC. Any additional pictures that would aid in re-locating the IPC should be taken.

7. Tree tags should still be placed where allowed by the land custodian. If this is not possible, additional stem map information may need to be collected in the sample notes where it would be difficult for a re-measurement crew to determine which tree is a given number using normal tree numbering procedures (such as two trees side by side of the same diameter).

8. Record in the comments section of the CH cards that normal sample marking has been altered , and briefly list the modifications to procedures. This will aid future crews to the sample in planning how to re-locate the IPC.

9. It is expected that increment boring should be allowed on nearly all sites.

Suggested methods for re-locating the IPC for audit and re-measurement

Planning before leaving for the field will significantly reduce the time it takes to re-locate a "hidden" sample. The procedures listed below have been tested and the extra time to re-locate a hidden sample can be quite minimal given proper planning.

On some samples the tie point will be very distinct and the tie line from the tie point to the IPC will be short. On samples such as these, conventional chaining methods could be used to re-locate the general area for the IPC pin. A GPS unit is an asset to confirm the location.

Samples where the tie point is indistinct and/or the tie line is long may require the use of GPS. The crew re-visiting the sample should obtain the corrected co-ordinates for the sample before leaving for the field. Using the GPS unit, the crew can navigate to the approximate location of the IPC pin, or offset as applicable. GPS is necessary on long tie lines as even a small change in bearing when re-chaining the line can result in the revisit crew being far enough away from the original IPC location that re-locating it could be impossible.

Once in the general area of the IPC, the re-visit crew should keep and eye out for tree tags if they have been placed (this should have been recorded in the original notes), soil pit, and cairns which are the most visible signs of being near the IPC plot center. If the reference tag is found, the crew should be able to find the reference pin using the reference tree details on the original Compass Card. If tree tags were placed originally, the direction of the tags will aid in the general location of the IPC, then check for stem map nails to accurately locate the IPC. The soil pit will indicate that the plot center is near, and may have been drawn on the Integrated Plot Details of the CL card. Other clues to look for are the species in the area (such as, a lone spruce in the plot where the rest of the trees are pine), or an overly large tree in the plot. Using the sector these trees are in can help to locate the general area of the IPC.

If the placement of tags and nails was not permitted in the original establishment, re-location may require the use of a metal detector to determine the exact location of the plot center. The metal detector can be used in a systematic way to cover the general area where the plot center pin is located. Crews should ensure that they use a metal detector capable of identifying aluminium, as some are capable of identifying ferro-magnetic materials (iron) only. Most samples have been established with an iron or steel bolt inserted in the aluminum pin, but this may not always be the case. The user manual for a detector will tell what materials it can detect.

Appendix J: Calculation of Basal Area

Field Calculation of Basal Area by Species

[Live, non-residual trees only]

Field Dot Tally

DBH Range	Species ___	Species ___	Species ___	Species ___	Species ___	Species ___
4.0 – 8.9cm						
9.0 – 14.9						
15.0 – 19.9						
20.0 – 24.9						
25.0 – 29.9						
30.0 – 34.9						
35.0 – 39.9						
40.0 – 44.9						
45.0 – 49.9						
50.0 – 59.9						
60.0 – 69.9						
70.0 – 79.9						
80.0 – 89.9						
90.0 – 99.9						
100.0 – 109.9						
110.0 – 119.9						
120.0 – 129.9						
130.0 – 139.9						
140.0 – 149.9						
150.0 – 199.9						
200.0 – 249.9						
Totals						

Table J1: Field Calculation of Basal Area by Species (live trees only) - Field Dot Tally

Field Calculation of Basal Area per Hectare by Species

Sample No.	

Used for determining Leading, Second and Other species for site tree selection

11.28m radius*, Live trees, no residuals

DBH Range	DBH Class (midpoint)	Tree Count by Species (Enter Tree Species Below)						Weighted Basal Area by Tree	Basal Area per Ha by Species (Enter Tree Species Below)					
4.0 – 8.9cm	6.5							0.33 *						
9.0 – 14.9	12.0							0.28						
15.0 – 19.9	17.5							0.60						
20.0 – 24.9	22.5							0.99						
25.0 – 29.9	27.5							1.48						
30.0 – 34.9	32.5							2.07						
35.0 – 39.9	37.5							2.76						
40.0 – 44.9	42.5							3.55						
45.0 – 49.9	47.5							4.43						
50.0 – 59.9	55.0							5.94						
60.0 – 69.9	65.0							8.30						
70.0 – 79.9	75.0							11.04						
80.0 – 89.9	85.0							14.19						
90.0 – 99.9	95.0							17.72						
100.0 – 109.9	105.0							21.65						
110.0 – 119.9	115.0							25.97						
120.0 – 129.9	125.0							30.68						
130.0 – 139.9	135.0							35.78						
140.0 – 149.9	145.0							41.28						
150.0 – 199.9	175.0							60.13						
200.0 – 249.9	225.0							99.40						

* The 4-8.9cm class is only measured on the 5.64m plot thus the proportionately higher BA/ tree

Tree count totals by species							Basal Area total by Spp						
Total Trees							All Spp total Basal Area						
							Percentage						

Instructions: 1) Enter Sample number, 2) enter tree species on both the left and right hand columns of the sheet, 3) enter tree count by diameter classes, 4) sum the tree count at the bottom of the sheet to confirm that no trees were missed, 5) Multiply the tree count for each species / dbh class combination by the weighted basal area for that dbh class and enter the result in the right hand columns of the spreadsheet, 6) total the basal area for each species, 7) summarize the total basal area for all species and record the number in all of the "All spp total Basal Area" columns, 8) record the percentage Basal Area for each species.

Table J2: Field Calculation of Basal Area per Hectare by Species for NFI plots only

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Note: this spreadsheet can be completed by hand or is also available as an Excel worksheet.

Appendix K: Low Woody Species and Intermediate Life Forms

List of low woody species and species of doubtful lifeform assigned to the herb (C) layer.

Scientific Name	**Common Name**	**Genus Code**	**Species Code**
Andromeda polifolia	bog-rosemary	ANDR	POL
Anemone multifida	cut-leaved anemone	ANEM	MUL
Apocynum androsaemifolium	spreading dogbane	APOC	AND
Apocynum cannabinum	hemp dogbane	APOC	CAN
Apocynum sibiricum	clasping-leaved dogbane	APOC	SIB
Arctostaphylos alpina	alpine bearberry	ARCT	ALP
Arctostaphylos rubra	red bearberry	ARCT	RUB
Arctostaphylos uva-ursi	kinnikinnick	ARCT	UVA
Aruncus dioicus	goatsbeard	ARUN	DIO
Asclepias ovalifolia	oak-leaf milkweed	ASCL	OVA
Asclepias speciosus	showy milkweed	ASCL	SPE
Cassiope lycopodioides	club-moss mountain-heather	CASS	LYC
Cassiope mertensiana	white mountain-heather	CASS	MER
Cassiope stelleriana	Alaskan mountain-heather	CASS	STE
Cassiope tetragona	four-angled mountain-heather	CASS	TET
Chamaerhodos erecta	chamaerhodos	CHAM	ERE
Chimaphila menziesii	Menzies' pipsissewa	CHIM	MEN
Chimaphila umbellata	prince's pine	CHIM	UMB
Comandra umbellata	pale comandra	COMA	UMB
Cornus canadensis	bunchberry	CORN	CAN
Cornus suecica	bog bunchberry	CORN	SUE

Scientific Name	Common Name	Genus Code	Species Code
Cornus unalaschkensis	cordilleran bunchberry	CORN	UNA
Draba spp.	draba	DRABA	
Dryas drummondii	yellow mountain-avens	DRYA	DRU
Dryas integrifolia	entire-leaved mountain-avens	DRYA	INT
Dryas octopetala	white mountain-avens	DRYA	OCT
Empetrum nigrum	crowberry	EMPE	NIG
Eriogonum androscaceum	androscace buckwheat	ERIO	AND
Eriogonum flavum	yellow buckwheat	ERIO	FLA
Eriogonum heracleoides	parsnip-flowered buckwheat	ERIO	HER
Eriogonum niveum	snow buckwheat	ERIO	NIV
Eriogonum ovalifolium	cushion buckwheat	ERIO	OVA
Eriogonum pauciflorum	few-flowered buckwheat	ERIO	PAU
Eriogonum umbellatum	sulfur buckwheat	ERIO	UMB
Fragaria chiloensis	coastal strawberry	FRAG	CHI
Fragana vesca	wood strawberry	FRAG	VES
Fragaria virginiana	wild strawberry	FRAG	VIR
Galium boreale	northern bedstraw	GALI	BOR
Gaultheria humifusa	alpine wintergreen	GAUL	HUM
Gaultheria hispidula	creeping snowberry	GAUL	HIS
Gaultheria ovatifolia	western tea-berry	GAUL	OVA
Geocaulon lividum	bastard toad-flax	GEOC	LIV
Kalmia microphylla	alpine bog-laurel	KALM	MIC
Linnaea borealis	twinflower	LINN	BOR
Lithospermum incisum	yellow gromwell	LITH	INC
Lithospermum ruderale	lemonweed	LITH	RUD

Scientific Name	**Common Name**	**Genus Code**	**Species Code**
Loiseleuria procumbens	alpine-azalea	LOIS	PRO
Luetkea pectinata	partridgefoot	LUET	PEC
Orthilia secunda	one-sided wintergreen	ORTH	SEC
Penstemon davidsonii	Davidson's penstemon	PENS	DAV
Penstemon ellipticus	oval-leaved penstemon	PENS	ELL
Phlox caespitosa	tufted phlox	PHLO	CAE
Phyllodoce empetriformis	pink mountain-heather	PHYL	EMP
Phyllodoce glanduliflora	yellow mountain-heather	PHYL	GLA
Polygonum cuspidatum	Japanese knotweed	POLY	CUS
Polygonum paronychia	beach knotweed	POLY	PAR
Polygonum polystachyum	Himalayan knotweed	POLY	POL
Polygonum sachalinense	giant knotweed	POLY	SAC
Pyrola spp	wintergreens	PYROLA	
Rhododendron lapponicum	lapland rosebay	RHOD	LAP
Rubus arcticus	dwarf nagoonberry	RUBU	ARC
Rubus chamaemorus	cloudberry	RUBU	CHA
Rubus lasiococcus	dwarf bramble	RUBU	LAS
Rubus nivalis	snow bramble	RUBU	NIV
Rubus pedatus	five-leaved bramble	RUBU	PED
Rubus ursinus	trailing blackberry	RUBU	URS
Salix artica	arctic willow	SALI	ARC
Salix cascadensis	Cascade willow	SALI	CAS
Salix polaris	polar willow	SALI	POL
Salix reticulata	netted willow	SALI	RET
Salix stolonifera	stoloniferous willow	SALI	STO

Scientific Name	**Common Name**	**Genus Code**	**Species Code**
Saxifraga bronchialis	spotted saxifrage	SAXI	BRO
Saxifraga cespitosa	tufted saxifrage	SAXI	CES
Saxifraga flagellaris	stoloniferous saxifrage	SAXI	FLA
Saxifraga oppositifolia	purple mountain saxifrage	SAXI	OPP
Saxifraga tricuspidata	three-toothed saxifrage	SAXI	TRI
Sibbaldia procumbens	sibbaldia	SIBB	PRO
Vaccinium caespitosum	dwarf blueberry	VACC	CAE
Vaccinium myrtillus	low bilberry	VACC	MYT*
Vaccinium oxycoccus *Oxycoccus oxycoccos*	bog cranberry	OXYC	OXY
Vaccinium scoparium	grouseberry	VACC	SCO
Vaccinium vitis-idaea	lingonberry	VACC	VIT

* VACCMYR is *V. myrtilloides*; *V. myrtillus* defaults to next letter, so code is VACCMYT

Appendix L: The Handling, Storage and Shipment of Tree Age Cores

Introduction

The National Forest Inventory requires the collection of age cores from selected trees of the major species within the NFI samples. This data is used for a variety of purposes including stand age calculations, growth relationships and site index calculations etc. These sample cores are counted in the field by sampling crews to attain age and radial increment data in the event cores are subsequently lost, and to attain information used in field succession interpretations. The cores are then recounted in the office under magnification to determine the actual age. The Federal Government will now be doing the microscope age counts rather than the field crew.

Objectives

The National Forest Inventory Program will be responsible for analyzing all age cores under magnification with the primary intent to study **growth patterns over the last 50 years**.

General Procedures

The age core data will be collected as per the current NFI process. The differences will be in the storage, labeling and processing of the age cores. As the sample cores are going to be analysed for a number of different purposes it will be very important to protect the samples from the development of fungal growth.

Detailed Procedures

1. Collect the age cores as per current procedures
2. The age cores are to be stored in plastic straws in the field with the ends of the straws stapled shut, or crimped to allow air movement through the straw. If the ends are sealed it may be desirable to cut small openings in the straw to allow air movement especially for wet and/or deciduous age cores.
3. It is permissible to use a soft pencil when performing ring counts in the field but do not use a pen of any kind as the marks tend to bleed throughout the core and inhibit counting the rings in the lab.
4. As these samples will be going to an outside source for analysis it is critically important that the samples are clearly labeled:
   (a) Sample number
   (b) Tree number
   (c) Tree species
   (d) Type

(i)	Top height	T
(ii)	Leading Species	L
(iii)	Second Leading species	S
(iv)	Other major species	O

   (v) Extra tree X
   (vi) Veteran tree V
   (vii) Indicate if the complete core is not included (for example - central portion is rotten (ROT) or center of tree could not be reached by the increment borer (CRC))

5. If possible, the cores should be dried in a 70 degree oven for several hours soon after their acquisition (radial increments must be completed before drying). It is not always possible to dry the cores in the field, but if the cores can be dried as soon as possible this greatly restricts the fungal deterioration of the cores. The cores may be left in the straws when they are dried in the oven, as the straws can tolerate 70 degree temperatures without melting or deforming. If moisture can be reduced to below 10 % fungal activity will be effectively arrested.
6. After drying the sample cores should be stored in a cool dry location prior to shipment to the Federal lab.
7. Bundle the cores from each sample into groups prior to shipment. The cores should be shipped, if practical, at the end of each field shift.
8. Include a list of the samples sent with pertinent details on tree number, type and comments on abnormal conditions.
9. Courier the age cores to the party identified by the NFI coordinator at Resource Information Branch.

Appendix M: Field Equipment and Field Cards for Surface Substrate, Forest Floor and Soil Bulk Density Sampling

Part A - Field Equipment

1 long-handled (≈ 50 cm), stainless steel soup spoon

1 pair heavy-duty clippers for cutting roots

1 stainless steel folding hand saw

2 heavy-duty trowels, one with a narrow blade and one with a wider blade

1 stainless steel ruler, 45 cm or tape measure

1 plastic, 1.0 L graduated cylinder

1 plastic, 100 mL graduated cylinder

5-mm plastic bags for lining excavated hole

10-mm plastic bags for collecting extracted soil samples

2 L of 4-mm glass beads (or water) in a plastic bottle with lid

20 cm x 20 cm (inside dimensions) square aluminium template

1 sharp knife for cutting humus and fine roots

flashlight or headlamp, useful in dark pits/site conditions (optional)

plastic sheet or tarp (optional)

knee pad (optional)

small plastic funnel for pouring beads back into container (optional)

balance capable of measuring up to 100 g at 1.0 g (optional)

Part B - Surface Substrate Tally

National Forest Inventory –Transect 1

Surface Substrate Tally

Instructions: For every meter along woody debris transect (corrected to horizontal), to the edge of the large tree plot, check box applicable to surface substrate type. For organic and buried wood, measure and record the depth in cm. Total the number of surface substrate occurrences in each category. Note: in plots where the organic layer is > 40 cm, depth measurements only need to be recorded every 2nd meter of transect. If the depth is greater than 40 cm record the value as >40cm. **For surface substrate definitions, see back of card.**

Data ID

CMI Project ID	CMI Sample #	NFI Network Label	Measurement Date (yy/mon/dd)	Crew (Initials) Person #1 Person #2

Meter	Organic	Depth (cm)	Buried Wood	Depth (cm)	Decaying Wood	Bedrock	Rock or Cobbles	Mineral Soil	Water
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Total									

You may need to put a dark line above the total row. The total boxes for buried wood, decaying wood, bedrock, rock and cobbles, mineral soil and water should not be shaded.

National Forest Inventory –Transect 2

Surface Substrate Tally

Instructions: For every meter along woody debris transect (corrected to horizontal), to the edge of the large tree plot, check box applicable to surface substrate type. For organic and buried wood, measure and record the depth in cm. Total the number of surface substrate occurrences in each category. Note: in plots where the organic layer is > 40 cm, depth measurements only need to be recorded every 2nd meter of transect. **For surface substrate definitions, see back of card.**

Data ID

CMI Project ID	CMI Sample #	NFI Network Label	Measurement Date (yy/mon/dd)	Crew (Initials)	
				Person #1	Person #2

Meter	Organic	Depth (cm)	Buried Wood	Depth (cm)	Decaying Wood	Bedrock	Rock or Cobbles	Mineral Soil	Water
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Total									

National Forest Inventory – Surface Substrate Definitions

Surface Substrate	**Definition**
Organic matter	Surficial accumulations of organic materials include the following: ▪ organic layers ≥ 1 cm thick overlying mineral soil, cobbles, stones or bedrock; ▪ layers of decaying wood < 10 cm thick; ▪ large animal droppings; and ▪ areas covered by dead mats of graminoids or other vegetation (mats include L and F horizon materials).
Buried wood	The proportion of the ground surface covered by buried wood: ▪ class 5 woody debris with > 50% **below** the surrounding surface; ▪ does not include freshly fallen material that has yet to decompose; ▪ may be covered by mosses, lichens, liverworts, or other living plants; ▪ if an organic layer has developed over the wood, buried wood must be > 10 cm thick otherwise it is classed as "organic matter".
Decaying wood	Fallen trees, large branches on the ground surface, and partially buried stumps with an exposed edge: ▪ does not include freshly fallen material that has not yet begun to decompose (e.g. decay class 1 and 2 logs). Note that if there is a recently fallen class 1 or class 2 log blocking measurement, move the sample point to just beside the log (see anomalous conditions); ▪ may be covered with mosses, lichens, liverworts, or other living plants; ▪ if an organic layer has developed over the wood, decaying wood must have > 50% of its thickness **above** the surrounding surface, otherwise it is classed as "buried wood".
Bedrock	Bedrock includes exposed consolidated mineral material: ▪ may have a partial covering of mosses, lichens, liverworts, or other epilithic plants; ▪ does not qualify as bedrock if covered by unconsolidated mineral or organic material ≥ 1 cm in thickness.
Rock or cobbles and stones	Rock (cobbles and stones) includes exposed unconsolidated rock fragments > 7.5 cm in diameter: ▪ may be covered by mosses, lichens, liverworts; or an organic residue layer < 1 cm in thickness; ▪ does not include gravels < 7.5 cm in diameter.
Mineral Soil	Unconsolidated mineral material of variable texture not covered by organic materials: ▪ may have a partial cover of mosses, lichens, and liverworts; ▪ often associated with cultivation, tree tip-ups, active erosion or deposition, severe fires, trails, or late snow retention areas; ▪ includes small cobbles and gravel < 7.5 cm in diameter; ▪ areas of living grass or forb cover where mineral soil is visible between stems are classed as mineral soil, as are exposed Ah or Ap horizons.
Water	Streams or areas of open water in bogs or fens. Note: this **does not include** "casual" or non-permanent water. The sample point should be recorded to reflect the conditions at the time of sampling, e.g. a gravel or sandbar below the high water mark for a stream would be recorded as mineral soil.

Part C Soil Bulk Density Sampling

National Forest Inventory – Soil Bulk Density, Forest Floor Organics and Mineral Soils

Instructions:

Forest floor organics – collect four samples of the forest floor/litter layer and record the depth of each sample.

Mineral soil samples – collect seven, 1.0 to 1.5-L samples of mineral soil at approximate depths of 0 to 15 cm, 15 to 35 cm and 35 to 55 cm. Record the volume and depth of each sample.

Data ID

Project ID	Plot Sample #	Network Label	Measurement Date (yy/mon/dd)	Crew (Initials)	
				Person #1	Person #2

Forest Floor Organics

Plot	Number of Sample Bags	Avg. Depth of Sample (nearest 0.5 cm)	Comments
Micro Plot 1			
Micro Plot 2			
Micro Plot 3			
Micro Plot 4			

Mineral Soil Samples

Plot	Location	Number of Sample Bags	Depth of Sample (nearest 0.5 cm)	Volume of Sample (mL)	Comments
Depth 1					
Depth 2					
Depth 3					
Depth 4					
Depth 5					
Depth 6					
Depth 7					

Appendix N: Field Card for the Collection of Small and Fine Woody Debris Data

National Forest Inventory – Small Woody Debris (pieces 1.1 to ≤ 7.5 cm in diameter) and Fine Woody Debris

Tally Instructions: For the last 10.0 meters of the woody debris transect, tally the number of pieces falling into each diameter class category. Use the dot tally method. Total the number of pieces at the bottom of each column. Record the average decay class of the fine woody debris pieces. Record the oven-dry weight of the pieces from both transects.

Data ID

CMI Project ID	CMI Sample #	NFI Network Label	Measurement Date (yy/mon/dd)	Crew (Initials) Person #1 Person #2

Piece Size Class	1.1 cm to 3.0 cm	3.1 cm to 5.0 cm	5.1 to 7.5 cm	Avg Decay Class of Pieces	Total ovendry weight for all four clip plots (grams)
Transect 1 Dot Tally					
Total Pieces					
Transect 2 Dot Tally					
Total Pieces					

Glossary

This section provides a glossary of the terms used in the manual. Where available, the source is provided. FPCode = the Glossary for the Forest Practices Code; SRM = Society for Range Management. For specific definitions of attributes measured in this inventory, refer to the index, which will direct you to a detailed definition.

AUM — animal unit month	the amount of forage required for one month by an average animal of the genus *Bos* (cow) aged 6 months or older. (FPCode) See also Forage Production.
auxiliary sampling plots	for purposes of this inventory, four plots set at 50 m in the cardinal directions from the Integrated Plot Centre, to enhance the information collected at the centre point.
azimuth	the horizontal angle or bearing of a point measured from the true (astronomic) north. Used to refer to a compass on which the movable dial (used to read direction) is numbered in 360°. (FPCode)
basal area per hectare	the area of the cross-section of tree stems near their base, generally at breast height and including bark, measured over 1 ha of land (FPCode). For purposes of this inventory, the cross-sectional area (in square metres) of all living trees 4.0 cm DBH or greater, expressed as a per hectare value for the entire polygon.
browse	shrubs, trees, and herbs that provide food for wildlife. (FPCode) See also Forage.
bryoids	formerly referred to as non-vascular cryptogams; includes mosses, liverworts, hornworts, and non-crustose lichens.
call grading	the process used to assign one of the Vegetation Resources Inventory grades (modified coastal log grades) to standing and fallen trees
canopy	the forest cover of branches and foliage formed by tree crowns. (FPCode)
check	a separation of the wood, at right angles to the annular rings, which runs toward or through the heart of the log.
clearcut	an area of forest land from which all merchantable trees have recently been harvested. (FPCode)
clinometer	a simple instrument for measuring vertical angles or slopes. In forestry, used to measure distance and tree heights. (FPCode)

coarse woody debris	see CWD
conk	a hard, fruiting body containing spores of a wood-decaying fungus. (FPCode)
crown	the live branches and foliage of a tree. (FPCode)

crown classes

Codes	Description
D	**Dominant** trees with crowns that extend above the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. They are somewhat taller than the codominant trees, and have well-developed crowns, which may be somewhat crowded on the sides, receiving full light from above and partly from the side.
C	**Codominant** trees with crowns forming the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crown is generally smaller than those of the dominant trees and is usually more crowded on the sides, receiving full light from above and little from the sides.
I	**Intermediate** trees with crowns below, but extending into, the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crowns are usually small and quite crowded on the sides, receiving little direct light from above but none from the sides.
S	**Suppressed** trees with crowns entirely below the general level of the crown canopy (may include trees, shrubs or other obstructions) around the measured trees, receiving no direct light either from above or from the sides.

crown closure	the percentage of ground area covered by the vertically projected crowns of shrubs or trees.

CWD — coarse woody debris	sound and rotting logs and uprooted stumps that provide habitat for plants, animals, and insects, and a source of nutrients for soil development. (FPCode). For purposes of this inventory — dead, woody material in various stages of decomposition, located above the soil; pieces larger than 7.5 cm in diameter (or equivalent cross-section), and not self-supporting (such as trees or stumps).
DBH — diameter at breast height	the stem diameter outside bark of a tree measured at breast height, 1.3 metres above the ground. (FPCode)
declination (magnetic)	the angle between true (geographic) north and magnetic north (direction of the compass needle). Declination varies from place to place and can be 'set' on a compass for a particular location. (FPCode)
diameter tape	a graduated tape based on the relationship of circumference to diameter which provides direct measure of tree diameter when stretched around the outside of the tree, usually at breast height. (FPCode)
DIB — diameter inside bark	the diameter of a tree or log excluding bark thickness. (FPCode)
downgraded logs	logs that otherwise would qualify for a specific grade but have a lumber loss deduction exceeding the requirements of that grade which will qualify for a lower grade.
field card	for this inventory, a set of cards provided to the field crew for recording the attributes measured on the ground.
foliar cover	the percentage of ground covered by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded. Foliar cover is always less than canopy cover; either may exceed 100% (S.R.M. 1989).
forage	grasses, herbs and small shrubs that can be used as feed for livestock or wildlife. (FPCode)
forage production	the weight of forage produced within a designated period on a given area. The weight may be expressed as either green, air-dry, or oven-dry. The term may also be modified as to time of production such as annual, current year's, or seasonal forage production (S.R.M. 1989). Production can also be expressed as animal unit months (AUMs), which is the amount of dry forage required by one animal unit for one month, based on a forage allowance of 26 pounds (11.7 kg) per day.

forage utilization	the proportion of current year's forage production consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole (S.R.M. 1989). For purposes of this inventory, utilization refers to the percentage of plant weight removed, not the percentage of plant height removed.
forbs	any broad-leafed herbaceous plants except Gramineae (or Poaceae), Cyperaceae and Juncaceae families (S.R.M. 1989) and, for forage measurement purposes, includes ferns and fern allies, club mosses and horsetails.
free-growing	young trees that are as high or higher than competing brush vegetation with one metre of free-growing space surrounding their leaders. As defined by legislation, a free growing crop means a crop of trees, the growth of which is not impeded by competition from plants, shrubs or other trees. Silviculture regulations further define the exact parameters that a crop of trees must meet, such as species, density and size, to be considered free growing. (FPCode)
GIS — geographic information system	a computer system designed to allow users to collect, manage and analyze large volumes of spatially referenced information and associated attribute data. (FPCode)
grading	classifying timber, lumber or logs according to quality or end-use. (FPCode)
graminoids	grass or grass-like plants (sedges and rushes) such as *Poa, Carex,* and *Juncus* species (S.R.M. 1989).
gross scale	the volume of log inside bark, including unsound wood and holes in the log.
herb	a vascular plant without a woody stem; includes ferns, fern-allies, some low woody plants, grasses, and grass-like plants.
Integrated Plot Centre	for purposes of this inventory, the location around which the detailed sample information is collected on the ground for all disciplines. All attributes are attached to the centre point.
intermediate life forms and low woody species	low shrub, generally unable to exceed 15 cm in height. In B.C., these are included in the herb layer for data collection purposes.
leading species	the tree species with the largest basal area per hectare based on all living trees equal to or greater than 4.0 centimetres D.B.H. tallied for a sample cluster. Residual trees from a previous stand are not included in the tally.

low woody species and intermediate life forms	low shrub, generally unable to exceed 15 cm in height. In B.C., these are included in the herb layer for data collection purposes.
merchantable lumber	good strong, general purpose lumber graded as better than utility or number 3, and not less than 2.6 m long.
merchantable volume	the amount of sound wood in a single tree or stand that is suitable for marketing under given economic conditions. (FPCode)
meso slope	the relative position of the area of interest within a catchment area.
mineral soil	soil consisting predominately of, and having its properties determined by, inorganic matter. Usually contains less than 20 per cent organic matter. (FPCode)
net factoring	a process used to estimate the net volume of sound wood (gross volume less decay) of an assigned log length.
OLK — occasional larger knots	in call grading, all sawlog grades can have occasional larger knots. OLKs are allowed to the extent of one per 3 m of log length and must be located where knot sizes for portions of logs are specified.
old growth	old growth is a forest that contains live and dead trees of various sizes, species, composition, and age class structure. Old-growth forests, as part of a slowly changing but dynamic ecosystem, include climax forests but not sub-climax or mid-seral forests. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another. (FPCode)
organic soil	soil containing a high proportion (greater than 20 or 30 percent) of organic matter. (FPCode)
peeler block	a segment (usually 2.6 m) of a log's length suitable for the manufacturing of veneer on a rotary lathe.
pencil bucking	the imaginary sectioning of a portion of a tree
phenology	the study of periodic biological phenomena which are recurrent, such as flowering or seeding, especially as related to climate (S.R.M. 1989).
polygon	a portion of land area delineated on mid-scale aerial photography of "like" or uniform land cover appropriate for applying land cover descriptions.
polygon number	a unique number assigned to each polygon as it is delineated.

powder worm	borings of the larva of the Western Cedar Borer causes a serious defect in cedar, and is not allowed in specific grades of cedar. There is no volume loss.
prism	an optical instrument used as an angle gauge, consisting of a thin wedge of glass which establishes a fixed (critical) angle of projection in a point sample. (Forest Practices Code)
residual	a living remnant of a former stand; in even-aged stands, the occasional (< 25 per ha) large stem of an older age class than the stand as a whole. Typically these trees may have larger diameters, a higher incidence or indications of decay, thicker bark, larger branching and "ragged" or flat tops.
ring shake	a separation of the wood following the circumference, or part of the circumference, of an annular ring.
second leading species	the tree species with the second largest basal area per hectare based on all living trees equal to or greater than 4.0 centimetres D.B.H. tallied for a sample cluster. Residual trees from a previous stand are not included in the tally.
seral stage	any stage of development of an ecosystem from a disturbed, unvegetated state to a climax plant community. (FPCode)
shrub	a plant that has persistent woody stems and a relatively low growth habit and that generally produces several basal shoots instead of a bole. It differs from a tree by its low stature (generally less than 10 m) and non-treelike form (Ministry of Forests 1994).
site index	an expression of the forest site quality of a stand, at a specified age, based either on the site height, or on the top height, which is a more objective measure. (FPCode)
site productivity	the inherent capabilities of a site to produce or provide the commodities or values for which the area will be managed in accordance with Section 4 of the Ministry of Forests Act, that is, timber, forage, recreation, fisheries, wildlife, and water. (FPCode)
small tree grades	for purposes of this inventory, includes trees that do not meet the minimum log sizes for Vegetation Resources Inventory log grades are assigned a small-tree grade developed for use in the Inventory.
SMR — soil moisture regime	the average amount of soil water annually available for evapotranspiration by vascular plants, averaged over several years.

snag frequency	the number of standing dead trees greater than 4 cm DBH ; expressed as a per hectare value.
SNR — soil nutrient regime	the amount of essential nutrients, particularly nitrogen, available to vascular plants over a period of several years.
soil pit	an excavation into the mineral soil of sufficient depth to allow assessment of variability in soil physical properties within a defined area of land. (FPCode)
stand	a community of trees sufficiently uniform in species composition, age, arrangement, and condition to be distinguishable as a group from the forest or other growth on the adjoining area, and thus forming a silviculture or management entity. (FPCode)
stolon	a horizontal stem which grows along the surface of the soil and roots at the nodes (S.R.M. 1989). A stoloniferous plant is a plant that has stolons.
stump	for purposes of this inventory, a stem less than 1.3 m in length with roots.
succession	the gradual supplanting of one community of plants by another, the sequence of communities being termed a sere and each stage seral. (FPCode)
surface clear	clear means free of knots or knot indicators. This material is highly valued for speciality products. Typical log grade criteria are shown as "90% surface clear, 66% surface clear, etc."
top height	top height is the height of the largest diameter tree on a 0.01 ha plot, providing the tree is suitable. Suitable trees are trees which provide heights and ages that can be validly used to estimate site index. This means that the top height tree must be healthy, not have a broken or damaged top, and not have its height growth affected by a competitor. The tree should not be a residual left from previous logging. If the largest diameter tree does not meet these criteria, then no top height sample is taken (a "null" plot). The largest diameter tree is selected regardless of species. (Forest Productivity Council, June 30, 1998)
tree	a woody plant, usually with a single main stem, capable of exceeding 10 m in height. For the purposes of this inventory, a tree is defined as a species listed in Appendix B: Change Monitoring Inventory Tree Code List; longer than 1.3 m with the roots attached to the bole; larger than 4.0 cm DBH.

twist	as it grows a tree may twist around on its axis with the result that the grain is no longer straight. Lumber cut from the tree has a slope to the grain which lowers the quality.
variable area plot sampling method	a method of timber cruising commonly used for industrial timber cruising in which sampling area (plot size) varies with tree diameter. (FPCode)
variable length call grading	recognizes only a minimum length and allows the cruiser to pencil buck at grade changes rather than at predetermined log lengths.
wildlife	raptors, threatened species, endangered species, game, and other species of vertebrates prescribed as wildlife by regulation. (FPCode)
wildlife tree	dead, decaying, deteriorating, or other designated trees that provide present or future habitat for the maintenance or enhancement of wildlife. (FPCode)

Index

Airport 283

Alpine 277, 281, 284

Beach 282

Bedrock 281

Blockfield 281

Bryoid 279

Bryoid - Lichens 279

Bryoid - Moss 279

Burned Area 282

Categories
  Non-Vegetated Land polygons 281
  Non-Vegetated Water polygons 284

code tables
  damage agents 261

Code tables
  damage severity 267
  mortality condition 267
  Tree Code List 255

Codes
  Land Cover Class 273

Cover types
  Non-Vegetated polygons 281

Cutbank 283

damage agents
  codes 261

Damage agents
  severity codes 267

Declination
  magnetic/annual change 287

Density classes
  Bryoid - Closed 280
  Bryoid - Open 280
  Dense 279
  Open 279
  Sparse 279
  Tree, Shrub Herb polygons 279

Exposed Land 281

Exposed Soil 282

Field cards
  Cluster Layout Card (CL) 212, 213
  Coarse Woody Debris 1 (EW) 215
  Coarse Woody Debris 2 (EC) 216
  Compass Card (CP) 210, 211
  Ecological Description 1 (EP) .. 221, 222
  Ecological Description 2 (ED) . 223, 224
  Header Card (CH) 208, 209
  Herb and Moss Layers (EH) 227, 228
  Range Sampling 1 (RS) 214
  Small Tree, Stump, and Site Tree Data (TS) 220
  Succession Interpretation (EO) 229
  Tree and Shrub Layer (ET) 225, 226
  Tree Details (TD) 217, 218
  Tree Loss Indicators (TL) 219

Field guides 231
  Age Measure Codes 236
  Forest Health – Damage Agent Codes 239
  Forest Health – Damage Agent Ranking 243, 244
  Forest Health – Damage Severity Codes 240
  Land Cover Classification – Levels I to IV 253
  Log Grade Summaries - Cedar 235
  Log Grade Summaries - Common Coniferous 234
  Log Grade Summaries - Cypress/Yew 236
  Log Grade Summaries - Deciduous . 234
  Log Grade Summaries - Fir/Pine/Larch 234
  Log Grade Summaries - Hemlock/Balsam 235
  Log Grade Summaries - Small Tree 234
  Log Grade Summaries - Spruce 236
  Loss Indicator Codes 236
  Net Factor Procedures for Loss Indicators 233
  Random Numbers 01-50 251
  Random Numbers 51-100 252
  Range Resources – Low Woody Species 250

  Range Resources – Phenology Codes ... 249
  Range Resources – Split Plot Procedures ... 249
  Range Resources – Utilization Classes ... 249
  Tree Classes ... 236
  Tree ID key - Conifers ... 245
  Tree ID key – Exotic Broadleaves ... 247
  Tree ID key – Native Broadleaves ... 248
  Tree Species Codes ... 237
  Wildlife Tree Attributes ... 238

Glacier ... 281, 282

Gravel Pit ... 283

Herb ... 279

Herb - Forb ... 279

Herb - Graminoid ... 279

Lake ... 284

Lake Sediment ... 282

Land ... 280

Land Base ... 276
  Non-Vegetated ... 276
  Unreported ... 276
  Vegetated ... 276

Land Cover Classification
  coding system ... 273
  decision chart ... 272
  Introduction ... 271
  Non-Vegetated diagram ... 275
  polygon attributes ... 272
  procedures ... 276
  uses ... 272
  Vegetated diagram ... 274

Land cover types
  Land ... 280
  Non-Treed ... 276
  Non-Vegetated polygons ... 280
  Treed ... 276
  Vegetated polygons ... 276
  Water ... 280

Landscape positions
  Alpine ... 277, 281
  Upland ... 277, 280
  Vegetated polygons ... 277
  Water polygons ... 283
  Wetland ... 277, 280

Lava Bed ... 282

Magnetic declination ... 287

Mine Spoil ... 282

Moraine ... 283

Mudflat Sediment ... 282

Non-Treed
  Bryoid polygons ... 279
  Herb polygons ... 278
  polygons ... 276
  Shrub polygons ... 278

Non-Vegetated
  categories ... 281
  Land polygons ... 280
  polygons ... 276

Non-Vegetated polygons ... 280

Ocean ... 284

Open Pit Mine ... 283

Polygon attributes ... 272

Pond or Lake Sediment ... 282

Railway Surface ... 283

Reservoir ... 284

Reservoir Margin ... 282

River Sediment ... 282

River/Stream ... 284

Road Surface ... 282

Rock/Rubble ... 281

Rubbly Mine Spoils ... 282

Shrub Low ... 278

Shrub Tall ... 278

Snow Cover ... 281

Snow/Ice ... 281

Stream ... 284

Tailings ... 283

Talus ... 281

Tree species
  codes ... 255

Treed
  Broadleaf 277
  Coniferous 277
  Mixed 278
  polygons 276

Unreported polygons 276

Upland 277, 283

Upland 280

Urban 283

Vegetated polygons 276

Vegetation types 277
  Bryoid 279
  Bryoid - Lichens 279
  Bryoid - Moss 279
  Herb 279
  Herb - Forb 279
  Herb - Graminoid 279
  Non-Treed 278
  Shrub Low 278
  Shrub Tall 278
  Treed - Broadleaf 277
  Treed - Coniferous 277
  Treed - Mixed 278

Water 280

Wetland 277, 280, 283